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VOL. CXLII.—No. 3690] LONDON: FRIDAY EVENING, OCTOBER 1, 1926 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. HIGH-TENSILE DRAWGEAR for RAILWAY WAGONS.
2. ELEVEN 4-WHEELED PETROL TANK WAGONS for RAILWAYS.
3. 3100 WELDLESS BUFFERS and PARTS thereof.
4. FOUR LOCOMOTIVE BOILERS.

Tenders due on the 15th October, 1926, for No. 1, on the 19th October, 1926, for Nos. 2 and 3, and on the 22nd October, 1926, for No. 4.

Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 3675

Wanted at Once, Temporary ENGINEERING ASSISTANTS of good experience in design of Docks and Heavy Masonry; also one experienced in design of Reinforced Concrete Wharves; and another accustomed to Steel Work.

Also DRAUGHTSMEN, quick, accurate, with general knowledge of Civil Engineering and Building Construction.

Preference given to ex-Service men.

Apply, giving full particulars of experience, age, salary required, when disengaged, and enclosing copy of recent testimonials, to CIVIL ENGINEER-IN-CHIEF, Admiralty, S.W. 1. 3644

British Guiana. MAYOR AND TOWN COUNCIL OF GEORGETOWN. APPOINTMENT OF CITY ENGINEER.

APPLICATIONS are INVITED by the Mayor and Town Council of Georgetown for the APPOINTMENT of CITY ENGINEER of GEORGETOWN, a city with population 55,000 and area of approximately 2½ square miles.

Candidates must be Chartered Civil Engineers or Members or Associate Members of the Institution of Civil Engineers, or have obtained the Testamur of the Institution of Municipal and County Engineers, and have wide experience in the designing and carrying out of works, especially waterworks, sewerage and sewage disposal (pumps being operated by electricity), surface drainage, and construction of streets; experience in reinforced concrete construction is desirable.

Special consideration will be given to applications of candidates with an Honour Degree in Engineering.

No candidate will be considered unless he is over 30 and under 45 years of age on 1st October, 1926.

The salary offered by the Council is £1200 per annum, with annual increment after the second year of £50 per annum until the salary reaches £1350 per annum. A motor car will be provided and maintained.

The successful candidate will be appointed on two years' probation and will be required to reside at the waterworks in the new residence, for which he will pay a rental of £100 per annum, to devote the whole of his time to the duties of the office, and not to engage in private practice or any other duty or employment.

The appointment and dismissal of City Engineer are according to law made by the Council subject to the concurrence of the Governor-in-Council of the Colony.

The appointee will be entitled under the Council's leave regulations to 3 months' vacation leave on full pay for every completed 3 years of service, and the Council may award a pension for satisfactory long service.

The successful applicant will be required to pass satisfactorily a medical examination before assuming office, and to be in the Colony on or about the 1st December, 1926.

By law the City Engineer is required to give security by himself and two sureties jointly and severally in a sum to be determined by the Council for the true and faithful performance of his duties and for the due and punctual accounting for and payment of all moneys received by him. The Council has determined that sum to be £625.

Applications must state age, experience and qualifications and be accompanied by not more than four recent testimonials from some recognised engineering authority and Borough or other Municipal Corporation.

All applications should be addressed to the TOWN CLERK, Town Hall, Georgetown, Demerara, British Guiana, care of the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, not later than 15th October, 1926, and envelopes endorsed in top left-hand corner "City Engineer, Georgetown, British Guiana." 3668

Civil Engineers (5) REQUIRED for the PUBLIC WORKS DEPARTMENT of TANGANYIKA TERRITORY for a tour of 20 to 30 months' service, with possible extension. Salary £480, rising by annual increments to £720 a year (with efficiency bar at £600), payable in the Territory in local currency. Outfit allowance of £30 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25 to 35, preferably unmarried, must have been regularly trained as Civil Engineers and be Corporate Members of the Institution of Civil Engineers. Must be capable of leveling, surveying, measuring up work and preparing designs of bridges, &c. Must have had at least three years' experience under a qualified Civil Engineer on the construction of harbour works, drainage works, water supply, or other public works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14402. 3667

University College of South WALES AND MONMOUTHSHIRE. COLEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY.

A SPECIAL CLASS in METALLOGRAPHY, suitable for persons engaged in Metallurgy, Mining and Engineering, will be held on SATURDAY MORNINGS at the University College, Newport-road, Cardiff.

The Class will commence on October 9th, 1926.

Particulars can be obtained from the undersigned.

D. J. A. BROWN, Registrar.

University College, Cathays Park, Cardiff. September 22nd, 1926. 3643

Mersey Railway Company. DISPOSAL OF PUMPING PLANT.

The Directors of the Mersey Railway Company are prepared to receive TENDERS for the PURCHASE and REMOVAL of ONE LARGE DEEP WELL PUMPING PLANT, situated at the Company's Power and Pumping Station, Shore-road, Birkenhead.

Form of Tender, with specification and general conditions, may be obtained from JOSHUA SHAW, M. Inst. C.E., General Manager and Engineer, Mersey Railway Company, Central Station, Birkenhead. 3642

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE. ARRANGED FOR CARD INDEXING.

Cane Sugar Factory at Luabo, East Africa (With a Two-Page Supplement). THE ENGINEER, 1 - 10 - 26.

Salvage Operations at Scapa Flow. THE ENGINEER, 1 - 10 - 26.

World Power Conference—No. IV. THE ENGINEER, 1 - 10 - 26.

Narrows Power Plant, Virginian Railway No. II. THE ENGINEER, 1 - 10 - 26.

Inland Navigation and Water Power in Spain. THE ENGINEER, 1 - 10 - 26.

Stresses in Cast Iron Pipe Sockets. (N.P.L. REPORT.) THE ENGINEER, 1 - 10 - 26.

Models for Demonstrating Electrical Principles No. VIII. THE ENGINEER, 1 - 10 - 26.

Continental Air Progress. THE ENGINEER, 1 - 10 - 26.

H.M.S. Ambuscade. THE ENGINEER, 1 - 10 - 26.

PUBLIC NOTICES

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :—

1000 ROUGH STEEL CARRIAGE AND WAGON TYRES.

Specifications and form of Tender can be obtained at the Company's Offices, 122, Gresham House, Old Broad-street, London, E.C. 2, on or after 27th September, 1926.

A fee of 20s. will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Monday, 11th October, 1926.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board, E. C. VOLKERS, Secretary. 3634

Bombay, Baroda and Central INDIA RAILWAY.

The Directors are prepared to receive up to Noon on Wednesday, 13th October, TENDERS for the SUPPLY of :—

1. STEEL MATERIAL (Angles, Flats, Plates, &c.), and up to 2.30 p.m. on Wednesday, 13th October, TENDERS for the SUPPLY of :—
2. METALS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG, Secretary.

Offices : The White Mansion, 91, Petty France, Westminster, S.W. 1, 29th September, 1926. 3676

City of Carlisle. ELECTRICITY DEPARTMENT. NEW ELECTRICITY GENERATING STATION.

TENDERS are INVITED for the LAGGING of the complete STEAM PIPING SYSTEM at the above Generating Station.

Specifications and drawings may be obtained from the undersigned on payment of a deposit of 10s. 6d., which deposit is returnable on receipt of a bona fide Tender.

The Corporation do not bind themselves to accept the lowest or any Tender.

Sealed and endorsed Tenders are to be delivered to the Electricity Offices, Victoria Viaduct, Carlisle, not later than first post, Monday, 18th October, 1926.

CHAS. W. SALT, M.I.E.E., City Electrical Engineer.

Electricity Offices, Victoria Viaduct, Carlisle 28th September, 1926. 3659

PUBLIC NOTICES

Manchester Corporation. DAVYHULME SEWAGE WORKS. PENSTOCKS.

The Rivers Committee invite TENDERS for the SUPPLY and ERECTION of PENSTOCKS at the Davyhulme Sewage Works. Plans may be seen and specification, bill of quantities and form of Tender obtained on application at the City Engineer's Office, Town Hall, Manchester, on payment to the City Treasurer of Two Guineas (£2 2s.), which sum will, after the Corporation have come to a decision upon the Tenders received, but not before, be returned to the persons submitting a bona fide Tender.

All cheques or postal orders are to be made payable to the order of "The Corporation of Manchester."

Tenders, enclosed in the official envelope and addressed to the Chairman of the Rivers Committee, are to be delivered, at the City Engineer's office not later than 9.30 a.m. on Friday, October 15th, 1926.

The Corporation do not bind themselves to accept the lowest or any Tender.

P. M. HEATH, Town Clerk.

Town Hall, Manchester, 20th September, 1926. 3582

The Assam-Bengal Railway COMPANY, Limited, is prepared to receive TENDERS for :—

30 THIRD-CLASS BOGIE CARRIAGES.

Specifications and Tender forms may be obtained at the Offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2. A fee of £1 1s. is charged, which cannot under any circumstances be returned.

Drawings may be had, at the cost of the tenderer, by application to Messrs. Hodges, Bennett and Co., Ltd., 76, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's Offices not later than Noon on Monday, the 18th October, 1926.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board, THOS. C. BRETT, Acting Secretary. 24th September, 1926. 3635

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, SALESMAN for Long-established Merchant Firm in Rangoon, with experience in Builders' and Road Contractors' Plant, Metal Work, and General Engineering. Age about 25. Excellent prospects for man of ability and address.—Write, stating salary required, to Box 278, Frost-Smith Advg. Service, 66, Finsbury Pavement, E.C. 2. P2299 A

SITUATIONS OPEN (continued)

WANTED.

ELECTRICAL ENGINEER by Continental Firm; only experienced salesmen, good connection in textile industry in Lancashire or Yorkshire, need apply. State salary and particulars.—Write to R. L. 317, c/o Als. Haasenstein and Vogler, Cologne-on-Rhine. P2272 A

WANTED, ENGINEER, Trained in Boiler Plant Instruments and Combustion, preferably with sales experience. A splendid chance for a man, with deep aggressive will to succeed, to join a rapidly growing concern with future prospects of exceptional compensation.—Address, 3657, The Engineer Office. 3657 A

ASSISTANT WORKS MANAGER for Modern Bridge and Structural Engineering Work. Competent man wanted with good organising and disciplinary capabilities, thoroughly conversant with the latest bridge and structural engineering shop practice. To a man showing initiative and ability the position may lead to a higher appointment.

Apply in writing, stating age, qualifications, and salary expected, to THE MOTHERWELL BRIDGE AND ENGINEERING COY., Ltd., Motherwell. 3655 A

CIVIL ENGINEER REQUIRED, Spain; £30 to £50 per month, depending qualifications; speaking Spanish. Also REQUIRED, JUNIOR ENGINEER; £20 to £30 per month.—Address, 3645, The Engineer Office. 3645 A

ELECTRICAL SHIFT ENGINEERS REQUIRED for 16,000-K.W. Power Station in healthy part of the East. Four years' contract, Rupees 475 up, with Provident Fund benefits; single man preferred. Only applications from candidates with electrical control grade experience will be considered. Applicants to state age, whether married or single, and all experience from commencement of apprenticeship.—Address, P2302, The Engineer Office. P2302 A

FIRST-CLASS MILLWRIGHTING ENGINEER REQUIRED to Take Charge of Works Plant; two 200 H.P. Diesels, generating sets, hydraulic plant, pneumatic plant, welding plant, and other machinery. Permanent job for keen, energetic engineer. Age 35 to 40, good organiser. State salary, giving references; Liverpool area. Applications should be accompanied by a recent photograph.—Address, P2321, The Engineer Office. P2321 A

REINFORCED CONCRETE DESIGNING ENGINEER REQUIRED IMMEDIATELY for London; previous experience with specialist firm and some knowledge of Constructional Steel Work essential. Must be used to competitive work and be able to estimate and carry through jobs independently with own squad. University training not imperative. Permanent job and advancement to right man. State age, technical training, experience, salary required.—Address, 3663, The Engineer Office. 3663 A

REQUIRED for India, the SERVICES of a LOCOMOTIVE ENGINEER; footplate experience essential. Applicants should be between the ages 24 and 32. The engagement will be for a minimum period of two years. Salary £500 per annum, and allowances, with free passages to and from India.—Address, giving full particulars of experience, 3652, The Engineer Office. 3652 A

REQUIRED for Service in Venezuela, SINGLE MAN, age 22-27 years, as APPRENTICE STILLMAN in Oil Refinery. Should have good experience Steam Fitting. Salary 200 dollars U.S. Cy. per month; outfit allowance and passage paid.—Write, stating age and full particulars, to Box "Z. A. 792," c/o Deacon's, Fenchurch-avenue, London, E.C. 3. 3672 A

SHIFT ENGINEER, with Steam and Pumping experience; must be trained fitter and capable maintenance repairs; REQUIRED for service in Venezuela. Salary 225 dollars U.S. Cy. per month. Outfit allowance and passage paid.—Write, stating age and full particulars, to Box "Z. B. 793," c/o Deacon's Advertising Offices, Fenchurch-avenue, E.C. 3. 3673 A

TOOL MAKER and MACHINIST with Experience of operating Milling Machine and capable maintenance repairs, REQUIRED for service in Venezuela. Salary 250 dollars U.S. Cy. per month; outfit allowance and passage paid.—Write, stating age and full particulars, to Box "Z. Z. 791," c/o Deacon's Advertisement Agency, Fenchurch-avenue, E.C. 3. 3671 A

WANTED, DRAUGHTSMAN for London, Young, neat and energetic, with good technical education and drawing-office experience of Piping, Mechanical Details and Structural Work. Good opening for willing worker.—Address, 3670, The Engineer Office. 3670 A

SITUATIONS OPEN (continued) Page 2.

SITUATIONS WANTED, Page 2.

PARTNERSHIPS, Page 2.

BUSINESSES and PREMISES (For Sale, etc.), Page 90.

MISCELLANEOUS, Page 2.

AGENCIES, Page 2.

MACHINERY, &c., WANTED, Page 2.

AUCTIONS, Page 90.

FOR SALE, Pages 4, 88 and 90.

PATENTS, Page 3.

WORK WANTED, Page 6.

For Advertisement Rates see Page 363, Col. 1.

INDEX TO ADVERTISEMENTS Page 80.

SITUATIONS OPEN (continued)

WANTED, Good MECHANICAL DRAUGHTSMAN, experienced in Cement Crushing and Grinding Machinery. One used to preparing complete lay-out schemes and with a knowledge of Structural Steel Work preferred. State particulars of experience, age, and salary expected.—Address, 3669, The Engineer Office. 3669 A

DRAUGHTSMAN REQUIRED, Accustomed to Elevating and Conveying Machinery. Experience in Constructional Steel Work an advantage. State age, experience, salary, and whether married or single.—Address, 3587, The Engineer Office. 3587 A

DRAUGHTSMAN (TEMPORARY) REQUIRED, experienced in the Lay-out of Production Machinery and preferably with some knowledge of Conveyor Plants, Runways, &c.—Write, stating age, experience, and salary required, to Box C. T., c/o R. Anderson and Co., 14, King William-street, W.C. 2. 3656 A

DRAUGHTSMAN, with Experience in Petrol Commercial Vehicles, fully conversant with chassis and engine. Practical experience essential.—Address, stating age, experience, and wage required, 3647, The Engineer Office. 3647 A

FIRST-CLASS MECHANICAL DRAUGHTSMAN REQUIRED AT ONCE for the South Coast. Experience in design of small detail work with minimum of supervision.—Address, stating age, experience, salary required, and when free, 3641, The Engineer Office. 3641 A

GOOD DETAILING DRAUGHTSMAN WANTED for London office. One thoroughly conversant with Steel-framed Building Work.—Address, stating age and experience and salary expected, also when free for engagement, P2304, The Engineer Office. P2304 A

HEAD DRAUGHTSMAN, Experienced in Machine Tool design, REQUIRED by Engineers in the North.—Address, stating age, salary, experience as designer and supervisor, P2300, The Engineer Office. P2300 A

REQUIRED by Consulting Engineers in Westminster, DRAUGHTSMAN experienced in Structural Steel Work design, including Bridges and Screw Pile Wharves.—Apply, giving full particulars of experience, also state age and salary required, to X. Y. Z., c/o Brown's, 39, Tothill-street, S.W. 1. 3664 A

FOUNDRY FOREMAN.—REQUIRED AT ONCE experienced FOREMAN for new Foundry. Must have expert knowledge latest practices in Malleable Castings, Furnace Production and Repetition Moulding; also have sufficient metallurgical experience to make analysis of Silica, Sulphur, Phosphor and Manganese. Only applications stating full details as to experience, age, salary, where employed will be considered. All correspondence treated strictly confidentially. A real opportunity for the right man.—Write, "A. E.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 3633 A

SITUATIONS WANTED

A M.I. MECH. E. (31) SEEKS APPOINTMENT as Mechanical Engineer in charge works dept. or similar capacity. Long experience with cranes, elevators, conveyors, and plant in connection with discharging ships. Distinguished war service.—Address, P2305, The Engineer Office. P2305 B

BOILER ATTENDANTS, ENGINEERS, SHOWROOM HANDYMEN and CLEANERS. For all reliable time-expired Service men write: NATIONAL ASSOCIATION FOR EMPLOYMENT OF REGULAR SAILORS, &c. (Room 6), Dock-road, Chatham. (Secretary, Commander Darwall, R.N.) Telephone, Chatham 10. All trades. No fees. P2245 B

CIVIL ENGINEER, British, Swiss University education, single (31), accomplished business man and linguist, experienced in surveying, difficult static structural calculations, plans, reinforced concrete, housing schemes, &c., DESIRES responsible POSITION, home or abroad. Excellent references.—Address, P2275, The Engineer Office. P2275 B

COMMERCIAL ENGINEER (25), Public School, shops, D.O., technical and commercial training, knowledge prime movers, boilers, chemical, mining, cement, pumping plants, &c.; good refs.—Address, P2312, The Engineer Office. P2312 B

ENGINEER (31) REQUIRES APPOINTMENT; experienced with recip. and turbine engines, water-tube and cylindrical boilers; burnt oil fuel 9 years.—Address, P2319, The Engineer Office. P2319 B

ENGINEER SEEKS POST, Home or Abroad; 10 years' exp. design and prod. m/c. tools, general, jigs, &c. Versatile, linguist.—Address, P2317, The Engineer Office. P2317 B

ENGINEER (28), 9 Years' Experience, Shops, D.O., commercial and public works, structural and mechanical, DESIRES progressive POST, Birmingham district. First-class references.—Address, P2311, The Engineer Office. P2311 B

ENGINEER (40), D.O. and Works. Exp. in General mech. and chem. engineering, tar products, boiler ef. tests, charge gen'l factory plant, control labour, SEEKS OPENING.—Address, P2225, The Engineer Office. P2225 B

MECHANICAL and ELECTRICAL ENGINEER, good draughtsman, used to modern plant, REQUIRES POSITION as Maintenance Engineer in factory, hotel, laundry, &c. Moderate salary; in London.—Address, P2314, The Engineer Office. P2314 B

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SUCCESSFUL ENGINEER, with Wide Experience of Railways and of a variety of Engineering Works and possessing the faculties of versatility, invention and organisation, SEEKS POSITION as MANAGING DIRECTOR or as GENERAL MANAGER with a seat on board of a Large and Progressive Company, at home or abroad. Highest references.—Address, P2253, The Engineer Office. P2253 B

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DRAUGHTSMAN (28), 7½ Years' Exp. Office Printing, copying and duplicating m/cs., capable designing to rough sketches or verbal instructions, good knowledge shop practice.—Address, P2310, The Engineer Office. P2310 B

PARTNERSHIPS

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ENGINEER, Public School Man, with Some Capital, to JOIN ANOTHER in an interesting business. Salary and commission should produce £1000 a year.—Address, P2277, The Engineer Office. P2277 C

PARTNERSHIPS and ACTIVE DIRECTORSHIPS WANTED in Mechanical, Constructional, Electrical Engineers, &c., for Clients with technical experience and capital from £1000 to £20,000.—GILBERT and PRATT, 18, Walbrook, London, E.C. 4. Ex. C

MISCELLANEOUS

CONCERN Manufacturing Dust Valves, 2½in. to 12in. dia., REQUIRE QUOTATIONS for LINERS in which C.I. circular plug revolves. Liner must constitute lubricated surface ensuring ease in operation.—Address, 3658, The Engineer Office. 3658 I

MISCELLANEOUS

SUBSTANTIAL ENG. FIRM REQD. Mfr. Under full Licence Weed Removing and Cultivating Implement, increasing all crops, suit all tractors. Univ. market. Principals only.—Address, P2324, The Engineer Office. P2324 I

EDUCATIONAL

COACHING for INST. C.E. EXAMINATION, Personal or by correspondence.—To G. W. M. BOYCOTT, Assoc. M. Inst. C.E., 1, Orchard Drive, Blackheath, S.E. 3. 3650 E

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter, B.Sc.), and ALL ENGINEERING EXAMINATIONS, personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Eng., London, Assoc. M. Inst. C.E., Chartered Civil Engineer, M.E.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams., comprising hundreds of successes. Courses may commence at any time.—Apply to Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), A.M.I.C.E., &c., 8/11, TRAFFORD CHAMBERS, 58, SOUTH JOHN-STREET, LIVERPOOL. Telephone No. 1118 Bank. Ex. E

LEARN DRAUGHTSMANSHIP.—There is a steady demand for competent Draughtsmen at good salaries. A qualified ENGINEER, with over 25 years' experience as a teacher, can ACCEPT a few more STUDENTS for his simplified Home-study Course. Coaching for professional examinations a speciality. Moderate fees.—Write for free booklet E, PERCY PITMAN, M.I. Mech. E., 25, Victoria-street, London, S.W. 1 (established 1894). Ex.

A well-known Continental Manufacturer of Water Meters embodying special features Desires Representation in Great Britain. — Address, 3677, The Engineer Office.

3677 D

AGENCIES

WANTED for London, also for the Provinces, AGENTS of standing for the sale of High-class Pumps (power driven). Must have influence and be able to introduce business.—Applications (which will be treated in confidence), by letter only, stating qualifications, district, and fullest particulars, to UNIFLO PUMP CO., Ltd., Fordhouses, near Wolverhampton. P2301 D

ADVERTISER, About to Reside in Sheffield, 25 years with present firm, DESIRES ANOTHER on small expenses and commission basis. Has high-class connection in S. Yorks., Derbyshire, and Notts. Replies treated confidentially.—Address, P2303, The Engineer Office. P2303 D

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ENGINEERS' REPRESENTATIVE, with Offices and good connection in London, WISHES to REPRESENT ENGINEERING or ALLIED FIRM. Remuneration mainly on commission basis.—Address, P2313, The Engineer Office. P2313 D

FIRST-CLASS GERMAN FACTORY, Manufacturing Whitworth thread screws countersunk, round and raised head and pressed nuts, also precision brass wood screws, DESIRES REPRESENTATIVE for United Kingdom. Correspondence is desired in German.—Address, 3577, The Engineer Office. 3577 D

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LONDON REPRESENTATIVES, Established 21 years, will UNDERTAKE another first-class AGENCY, exceptional connection and references, marine especially, also export, railway, electrical, oil companies, &c. Replies treated strictly confidential.—Address, P2273, The Engineer Office. P2273 D

MACHINERY, &c., WANTED

WANTED, Good as New HORIZONTAL SPINDLE PLANO MILLER, 8ft. table, 24in. wide, arranged for electric drive.—Write, stating price and where to be seen, to Box 165, Selfs, Fleet-street, E.C. 4. 3666 F

WANTED, PRECISION LATHE, 7½in. Centre, S.S. and S.C., Norton type gear-box, all-geared head, to admit 5ft. between centres. Must be in first-class condition.—Address, 3642, The Engineer Office. 3642 F

For continuation of Small Advertisements see page 3.

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MANNING, WARDLE & CO., LTD.
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LONDON OFFICE: Mr. H. J. Heagerty, 34, Victoria Street, Westminster, S.W. 1.

A Seven-Day Journal

The Proposed St. Paul's Bridge.

Some interesting statements and opinions concerning the proposed St. Paul's Bridge and its probable effect on the stability of the Cathedral were made at the meeting on Friday last week of the Royal Commission on London Cross River Traffic. Mr. J. R. Pakeman, of the City Corporation, stated that the estimated cost of the bridge was £3,306,696 and that the Corporation had already expended £1,270,000 on parliamentary expenses and the acquisition of property on the proposed site. Mr. Basil Mott, who prepared the designs and contract drawings for the bridge argued that its construction and use would not endanger the Cathedral by vibrations. No excavations would be made below the level of the foundations of existing buildings, and a large number of basements now in existence would be filled in. The roadway would be moved 15ft. farther away from the Cathedral, and even though increased traffic were attracted to the neighbourhood, it would be at a point at which the Cathedral was best fitted to withstand it. He remarked that while the work now being done on the piers was necessary, the biggest crisis in the stability of the fabric occurred during its construction. Answering Professor Inglis, he stated that he knew of no case in which a building had been fractured as a result of vibration produced by traffic. Mr. W. R. Davidge, president of the Town Planning Association, expressed his society's disapproval of the St. Paul's Bridge scheme and its approval of a bridge at the Temple passing across the Embankment and leading into the Strand by way of a circus. He also favoured a new Charing Cross bridge, which need not necessarily involve the removal of the existing railway station. Mr. Davidge, in addition, urged that some of the unused or little-used railways leading out of London, such as the line from Holborn Viaduct Station and the line from Addison-road to Clapham Junction, should be converted into new high-level through roads for fast motor traffic.

The Shipbuilding Trades Investigation.

A further small step in the direction of strengthening our threatened shipbuilding industry was taken at York on Thursday, September 23rd, by the executive representatives of the twenty-one shipbuilding trades of the country, who met to discuss the report of the Joint Committee of Inquiry into the subject of foreign competition and working conditions in the shipbuilding industry. After some four hours' discussion it was decided by a small majority to adopt the report, but an important reservation on the subject of demarcation was made. While approving of the general principles of the report, it was recommended that the questions of interchangeability of labour and demarcation should be referred to the unions of the different trades concerned. In the resolution passed it was stated that the meeting could not admit the arbitrary right of the employer to re-allocate the work of craftsmen without joint consultation and agreement between the employers and the individual unions concerned. The decision of the unions will come before the Shipbuilding Employers' Federation at an early date. Actually a meeting of the employers took place at Carlisle on Friday, September 24th, but, having in view the spirit of co-operation which had been maintained throughout the joint inquiry, it was decided to await the new joint meeting at which the position of the unions would be explained. In considering the report at York reference was made to the recent losses of the German firm which built the five motor ships, the awarding of the contract for which gave rise to the inquiry. It was recalled that one finding of the joint inquiry was that British labour was not more costly or less productive than German labour, while the investigations further went to show that there were no shipbuilding workmen in any country superior to British workers, either in skill or in assiduity in reaching satisfactory production.

Armament of New British Battleships.

Illustrations of H.M.S. Nelson have been published this week, showing the battleship being fitted out at the Armstrong yard on the Tyne, where she was launched thirteen months ago. These views, which depict the forward part of the vessel, remove whatever doubt may have remained as to the character of her main armament. Three triple turrets are clearly seen on the forecastle deck, disposed in pyramid fashion, the middle turret being raised to permit its guns to fire direct ahead over the bow turret. The depth of the gun ports indicates that the weapons will be capable of a high degree of elevation, a principle that was first adopted in H.M.S. Hood. Abaft the third turret arises a lofty superstructure, which is understood to have replaced the conventional type of tripod mast. It has been officially announced that the guns are of 16in. calibre, so that the vessel mounts no less than nine of our most formidable pieces. All of them can be fought on either beam and six ahead. The disposition of the turrets will allow a heavy concentration of fire through a considerable arc abaft the beam, but apparently no heavy guns can be trained astern. Apart from the general novelty of her design, the Nelson is remarkable as being the first British battleship to have triple turrets, and the first to carry 16in. guns, although weapons of this calibre are mounted in three American and two Japanese ships. On the other hand, the Nelson, having nine guns in all, against eight in her foreign contemporaries, is the most heavily armed warship afloat. She and the sister ship Rodney, which is also completing, will form the spearhead of our post-war battle fleet.

Special Libraries.

As on the two former occasions of its existence the Association of Special Libraries and Information Bureaux held its annual meeting at Balliol College, Oxford. On Saturday last, September 25th, Lord Burnham delivered an introductory address and subsequently on that and the following day many short papers were submitted for discussion. The subjects dealt with extended over a wide field, books being the connecting link between them all. The immediate object of the Association is the preparation of a great directory of special collections of books and other literary material in public and private libraries. The task is a large and costly one, but assistance is being derived from a grant of £2000 made by the Carnegie Trustees. A good many libraries already arrange specialised collections and information bureaux are being founded in connection with many industrial and commercial enterprises. Some of this work is done with an eye to business, the collection of data for "business forecasting" forming an important part of it; whilst the facilitation of technical and scientific research is the principal object of other collections. To these subjects several papers were devoted, but such general questions as the training of students in the use of libraries and the collection of material for research theses were also dealt with.

Imperial Airways.

For a second time Imperial Airways, Ltd., has failed to secure a profit on the year's trading. Speaking at the annual meeting held in London last week, the chairman, Sir Eric Geddes, announced that the board proposed to call up the remaining 10s. per share of the share capital. The money, he said, was required to complete the machines and equipment for the new Egypt-India service which the company, under contract with the Air Ministry, was to open next January, and to provide adequate working capital for the European services. Sir Eric incidentally stated that the value of the aircraft and engines owned by the company now stands at £181,000. During the year nearly £19,000 had been written off in respect of units which were considered obsolete. The additions during the year represented a sum of £63,500 and were mainly concerned with the purchase of multi-engined machines. Two shareholders at the meeting expressed the view that the company should be wound up, but it was generally held that such a step would be premature.

Wreck Statistics.

The recently published wreck returns of Lloyd's Register of Shipping, which have now been completed for the three months ended March 31st, 1926, show that during that period a total of 89 steamers and motor ships and 35 sailing ships with a gross measurement of 139,766 tons were lost in consequence of casualty or stress of weather. Of that number, 26 ships, either steamships or motor ships, representing 35,609 tons, were registered in Great Britain or Ireland. Other causes accounted for the loss of a world total of 68 steamers and motor ships and 7 sailing ships lost, aggregating 170,759 gross tons, of which 18 steamers and motor ships and one small sailing ship were British and amounted to 42,669 tons. The gross reduction in the mercantile fleets of the world which was reported during the first three months of the year was therefore 157 steamers and motor ships and 42 sailing ships, making a total of 310,525 gross tons, of which 44 steam and motor-propelled ships and one 712-ton sailing vessel were registered in Great Britain and Ireland, representing a total of 78,278 gross tons. An analysis of the returns for the steamers and motor ships showed that out of the 89 ships lost, 6 were abandoned, 12 foundered, 6 were reported as missing, 6 were burnt, 13 were lost as a result of collision, and the remaining 46 were wrecked. Most of the vessels were of small tonnage and none of them exceeded 8000 tons. The total tonnage lost in the case of steamers and motor ships may be expressed as 0·32 per cent. of the ships owned and 0·18 per cent. of the tonnage owned in Great Britain and Ireland.

Mr. Ford's Latest Step.

When twelve years ago Mr. Henry Ford announced that the minimum wage in his factories was to be £1 a day he did not startle American industrial circles to a greater extent than he has done within the past week by intimating that for the future all those engaged in his different establishments would work five instead of six days a week. The new arrangement will affect between 220,000 and 250,000 workpeople. It has been adopted after a two months' experimental period. The day's work will continue to be on the eight-hour basis without overtime, and the wages per day will not be altered. As usual, there is no sentiment, but only cold economic fact behind the new order. Mr. Ford argues that prosperity demands increased leisure for the workers in order that they may have time and inclination to develop needs and so supply a demand for industrial products. No industry, he says, can be built up on the wants of a man who after working hours has no opportunity or desire to do anything but eat and sleep. At the Trafford Park works of the Ford Company the scheme has aroused great interest. These works employ 2000 people, who work forty-four hours a week and, men and women alike, receive 3s. an hour as the minimum wage.

The Palestine Electric Corporation.

It is reported that the Marquis of Reading, Sir Alfred Mond, Sir Hugo Hirst, and Mr. James de Rothschild are joining the board of directors of the Palestine Electric Corporation, Ltd., incorporated in Palestine three years ago for the purpose of carrying out Mr. Rutenburg's scheme for the electrification of Palestine. The capital required for constructing the Jordan hydro-electric works has now been definitely secured. The total subscribed capital of the Palestine Electric Corporation, which includes the expenditure already incurred in the execution of works at Jaffa, Haifa, and Tiberius, amounts to £950,000. The preliminary work on the Jordan scheme will be begun upon the arrival in Palestine of Mr. Rutenburg, who is said to be leaving London for Palestine next week. The Jordan works are expected to be in full swing early next year.

Dismantling a Floating Dry Dock.

About the end of last week there passed under the Forth Bridge in charge of tugs one of the floating dry docks which was delivered by Germany after the war. The dock in question was known as the Kiel No. 1 dock, and since its arrival from Germany it has been lying at Portsmouth. Recently, it was bought from the Admiralty by the Rosyth Shipbreaking Company, Ltd., and will be dismantled at H.M. dockyard, Rosyth. The structure is probably the largest that has ever passed through the arches of the Forth Bridge. Its construction was begun at Kiel by the Howaldtswerke in 1909, and it lifted its first large ship some two years later. The following are the principal dimensions of the dock:—Overall length, 656ft. 2in.; breadth over walls, 183ft.; overall height, 62ft. 4in. There are five sections to the dock, and it has a designed lifting capacity of about 40,000 tons.

Professor G. F. Charnock.

The retirement is announced of Mr. George Frederick Charnock from the Chair of Engineering at Bradford Technical College. Professor Charnock is in his sixty-seventh year, and became head of the Department of Engineering at the Bradford College as long ago as 1890, becoming Professor of Engineering in 1903. In early life he studied at the Leeds School of Science, and after acquiring practical experience as a pupil under Mr. H. P. Holt, M. Inst. C.E., and as assistant to the late Mr. P. Thursby, M. Inst. C.E., he was engaged in 1883 in the resident engineer's office of the West Lancashire Railway under Sir Charles Fox and Sons. From 1885 to 1889 he conducted classes at the Leeds School of Science, which he left to proceed to Bradford. He intends to engage in a certain amount of consulting and inspection work, and has been asked to give special courses of lectures at the Bradford College. He will be succeeded in the professorial chair by Mr. H. W. Swift, M.A., B.Sc., lately chief lecturer in mechanical engineering at Leeds University.

The Coal Dispute.

The terms advanced by the Government for the settlement of the coal dispute still stand, but during the week it was intimated that they cannot remain indefinitely open for acceptance. While not wholly rejecting them, the miners' leaders replied by proposing an alternative scheme of settlement. As a temporary arrangement to secure the resumption of work, the miners' executive offered to recommend the miners to accept wages not less than those payable under the terms of the 1921 agreement. The terms of a national wages agreement would then be referred for decision to an independent tribunal, charged with the duty of considering and applying to the mining industry the recommendations of the Royal Commission on the Coal Industry. On and after a date to be fixed by the tribunal every man affected by the award would be entitled by law to receive wages in accordance with the decision. These proposals were considered by the Government, but it was held that they did not constitute a possible basis of settlement that could be used to end the dispute. The miners' terms involved a refusal to consider district settlements, and by implication a general refusal to depart from the seven-hour day. On both these points the owners continue to show a united front. So that the miners' offer to accept a temporary reduction of about 1s. a day naturally failed to achieve their acceptance. On Wednesday, September 29th, a delegate conference of the Miners' Federation met in London to consider the situation, but no decision was reached.

Luabo Cane Sugar Factory.

No. I.

In the natural interest which has recently been taken in the establishment and development of the beet sugar industry in our own country, the paramount importance of the cane sugar industry to our British Colonies, and to other countries overseas in which British engineers have interests, may easily be overlooked. British engineering firms have gained a world-wide reputation for the design and supply of the crushing machinery and other plant necessary for the cane sugar industry, and such machinery is an important factor in our export trade.

With a view to placing before our readers an example of recent practice in cane sugar engineering it is proposed in the present articles to describe and illustrate a modern sugar factory which has been erected and for two years has been in operation at Luabo on the north bank of the Zambesi River in Portuguese East Africa. The factory is owned by Sena Sugar Estates, Ltd., of London, and it is the latest of the four factories belonging to that company which are in operation on the Zambesi River. The complete contract for the building and equipment of the factory at Luabo was placed with the Mirrlees Watson Company, Ltd., of Glasgow, and the design and arrangement of the plant was worked out by the firm to the specification of and in conjunction with Mr. Charles Hornung, the engineer of Sena Sugar Estates, Ltd.

The Factory Arrangement.

The general arrangement of the factory will be seen in the drawings reproduced in to-day's Supplement. Its nominal rated capacity is 50 tons of cane per hour, or 1200 tons per day of twenty-four hours, but it has been worked at an output of 1400 tons per day with every success. At a recent annual meeting of the company the chairman, in commenting upon the work of the factory, said:—"The new factory at Luabo has completed its crop and it is giving the utmost satisfaction. At this factory the crushing rate has reached the figure of 75 tons per hour, which means that in a normal season—given sufficient cane—it will be capable of producing about 25,000 tons of sugar."

The production at present is 96 deg. polarisation raw sugar, but as the accompanying drawings show, the buildings and stagings of the factory are designed to accommodate additional plant for the manufacture of plantation white sugar at a future date. There is also accommodation for the installation of the necessary plant to double the present output. The steel-framed buildings which house the entire factory equipment consist of two 65ft. roof spans covering the main factory bay with a 70ft. roof span over the boiler-house and the power plant. Three views in the main building are reproduced in Figs. 2, 3, and 4 on page 353. They show the milling plant, the evaporating plant and the centrifugals respectively.

Cane is transported from the plantation to the factory on the company's light railway in cars each of 3 tons capacity, the trains being drawn by 12-ton locomotives. The railway is 24in. gauge and storage sidings capable of accommodating some 600 cars of cane are arranged in the factory yard. After weighing, the cars pass to the cane unloader, which is illustrated in Fig. 5. The cane unloading shed is served by six sets of rails, which take the full and empty cars. The full cars are passed beneath the mechanical unloaders, which consist essentially of a series of endless chains with rake prongs attached at intervals so that the cane is automatically raked into the cane carrier. Each unloader is driven by its own electric motor, and all three can be worked at the same time. In order to ensure that the cane crushing plant runs at its maximum capacity it is essential that a constant feed of cane be supplied to the cane carrier, which is a steel apron conveyor 210ft. in length with a width of 6ft. It is steam driven by a two-cylinder engine, through reducing gears, so that a rate of travel of about 20ft. per minute is normally maintained. When desired, the speed of the engine can be altered so that the quantity of cane delivered to the crushing mills may be varied.

The cane is levelled and the "feed" consolidated by a number of steel knife blades mounted on hubs opposite each other, revolving at a speed of 400 revolutions per minute. The cane-leveller, as this device is termed, is driven by a belt from an electric motor and is mounted over the cane carrier so that the cane passes beneath it on its way to the crushing plant.

The Milling Plant.

The milling plant consists of a Mirrlees fourteen-roller mill comprising a two-roller preparatory crusher and four three-roller mills, Nos. I. to IV. All the mill rollers are 34in. in diameter and 72in. long. Three horizontal Corliss steam engines drive the plant through compound spur reduction gearing. Each engine has a throttle valve for slowing down or stopping in case of an emergency, and the engine stop valves can be operated by extended spindles and hand wheels from a platform arranged over the crushing mills as shown in Fig. 2. This view also shows part of the boiler-house to the right of the mill house.

The engine which drives the preparatory crusher has a cylinder of 22in. diameter with a stroke of 48in., whilst each pair of crushing mills is driven by an engine with a cylinder 28in. diameter and a stroke of 54in. The indicated horse-power developed by the crusher engine when dealing with a maximum tonnage of cane is about 166, whilst that of each mill engine is about 335, with an engine speed of 50 revolutions per minute. By using an independent engine to drive the crusher its speed may be varied according to the quality of the cane, and a regular feed to the rest of the crushing plant be maintained. All the mill engines were built by the Mirrlees Watson Company, Ltd., and are of a very heavy design for continuous service. Frames of the mammoth type are employed and long-range cut-off gears are fitted. With a single excentric Corliss valve gear the maximum cut-off is limited to about 40 per cent. of the stroke but by the application of a long-range gear, a cut-off equal to that of either a slide or piston valve engine is obtained. Single excentrics are used, as at times it becomes necessary to reverse the crushing rollers by disconnecting the excentric from its wrist plate and operating the wrist plate by a hand lever.

The compound gearing reduces the engine speeds of about 50 revolutions per minute to 2·1 to 3 revolutions at the mill rollers. All the first reduction gears are made in cast steel with machine-cut teeth in order to ensure smooth and quiet running. The second reduction gears are also of cast steel but with machine moulded teeth. A top view of the mill and gearing is shown in Fig. 2 on page 353, and in Fig. 1 a side view of the complete milling plant erected in the builders' works. The preparatory crusher through which the cane first passes is seen to the left in Fig. 1. It is of the low-level Krajewski type and consists of two deeply intermeshing corrugated rollers of cast steel carried on heavy shafts in cast steel headstocks. The lower of the two rollers is driven by spur gearing through a connecting tail bar with two loose muff couplings, whilst the upper roller is driven by a steel pinion keyed on to its shaft, which meshes with a similar pinion on the lower roller.

Each crushing mill comprises a set of three grooved cast iron roller shells mounted on large diameter steel shafts carried in headstocks. A trash-turner bar guides the cane from the front to the back roller. As the top and the back rollers are set much closer together than are the top and front or feed rollers, better crushing is obtained with a three-roller mill than is possible where only two-roller mills are employed. From the view reproduced in Fig. 1 it will be seen that the top roller is driven by spur gearing through a tail bar with two loose muff couplings, whilst the two lower rollers are driven by pinions meshing with a similar pinion on the top roller shaft.

One of the special features of the Mirrlees design of crushing mill is the use of a rigid type of trash-turner bar supported on the mill headstocks by a wide base. This arrangement prevents vibration and groaning whilst the cane is being crushed. The design of juice tray is new in cane milling practice. The trays slope steeply towards two gutters which run across the mill bed, one under each lower roller. The arrangement is such that pieces of crushed cane or "cush-cush" are readily washed into the gutters by the flow of the expressed juice. If the "cush-cush" is allowed to accumulate in the mill bed fermentation is set up with a consequent loss of sugar. The headstocks of the mills are designed to reduce to a minimum the distance between the back and the front rollers. The lower roller bearings of the mills are fitted with renewable liners secured by tap bolts to steel mixture shells, the space between the liner and the shell forming the water jacket. All the mill bearings are water jacketed and the bearings for the top rollers are fitted with mechanical oil feed lubricators. In addition to the ordinary roller grooves the front rollers of mills No. III. and No. IV. and the back rollers of mills No. II., No. III., and No. IV. are provided with Messchaert juice grooves. These special grooves, each $1\frac{1}{4}$in. deep and $\frac{3}{16}$in. wide, form channels for the outward flow of the juice from the points of greatest pressure between the rollers. If drain channels of the kind are not provided the expressed juice has to force its way out through the incoming mass of cane.

The mill rollers are made of a special quality of hard coarse grained cast iron combining good wearing qualities with a rough surface for gripping the cane. If the roller metal is not sufficiently coarse in structure the rollers tend to slip and become quickly polished, so that the mills will not deal with the designed quantity of cane. The top rollers are provided with detachable flanges so that they can be used as side rollers by removing the flanges. Both the crusher and the mill top rollers are fitted with hydraulic pressure regulators, enabling loads of about 500 tons to be applied. The regulators consist of rams working in gun-metal-lined cylinders embodied in the top caps. The rams press on steel pads on the top of the top roller bearings, and the covers of the hydraulic cylinders are held in place by locking devices similar to a gun breech plug,

FIG. 1—THE MILLING PLANT ERECTED IN THE BUILDERS' WORKS

FIG. 2—MILLING PLANT WITH PART OF BOILER ROOM

FIG. 3—VIEW IN MAIN BAY LOOKING TOWARDS VACUUM PANS

FIG. 4—BATTERY OF CENTRIFUGALS

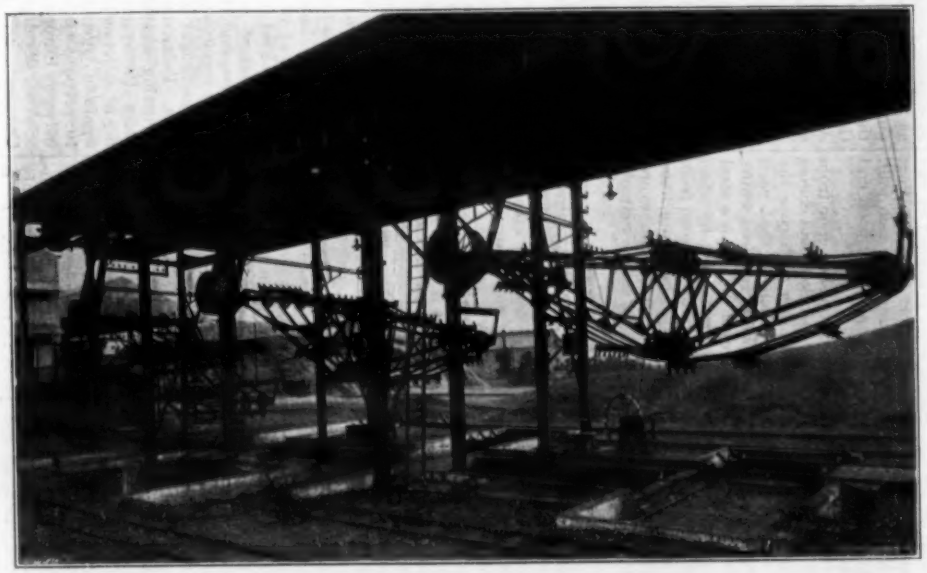


FIG. 5—GENERAL VIEW OF CANE UNLOADERS

so enabling the leather packings of the hydraulic rams to be readily renewed.

The load on the top crusher roller is applied by two differential accumulators, one for each bearing, whilst the mills have one accumulator for each mill, serving the two hydraulic cylinders, one at each end of the top roller.

The conveyors for the megass or crushed cane from one mill to another are driven by sprockets and chains from the top rollers of the mills. In each case the driven sprocket has a friction clutch so that each conveyor may be started or stopped as required whilst the mills are running. The conveyor bottom is a steel trough along which the megass is moved by steel scrapers fixed to endless chains. As will be seen from Fig. 2, gangways of chequered steel plate are fixed alongside the mills for easy access to the conveyors, the top roller bearings and the driving engine controls.

Crushing and Juice Extraction.

As the cane enters the crusher from the cane carrier chute it passes between the rollers and is cut into lengths of 4in. to 6in. By the preliminary crushing process the structure of the cane is broken down and about 50 per cent. of juice is extracted. The juice expressed passes through a perforated false bottom in the bed-plate of the crusher and the crushed cane falls into the boot of an elevator and is delivered to the first mill. The crushed cane is subjected to a double squeeze in each three-roller mill, making eight passes in all through the rollers of the four mills.

At the mills the juice expressed from the megass or crushed cane falls on to the mill beds and the cross gutters, then to the juice gutters alongside the mills. The general arrangement of the juice gutters is indicated in the plan in to-day's Supplement. Three copper gutters are provided for collecting the juice. The juice from the crusher and mills No. I. and No. II. flows into the main gutter, whilst the juice from the mills Nos. III. and IV. flows into two separate gutters.

The crusher and the first mill may express up to 65 per cent. of the juice in the cane, but as the megass leaving the last mill is used as fuel in the boiler furnaces it is essential that as much as possible of the remaining juice should be expressed from the megass. When dry crushing—that is, crushing without the addition of water—is employed, then the juice remaining in the megass as it leaves the last mill is only slightly poorer than the juice in the cane. It is impossible to reduce the moisture content of the final megass below 40 per cent. by crushing, and were not other means employed a large percentage of sugar would pass to the boiler furnaces in the megass. To reduce this loss the juice remaining in the megass is diluted by a system of return maceration or dilution. Water is sprinkled on the megass as it leaves mill No. III. and the diluted juice from mill No. IV. is returned to the megass from No. II. mill; the dilute juice from mill No. III. is sprinkled in front of mill No. II., in which mill it is again expressed from the megass and passes into the main gutter. Mills No. II. and No. III. are fitted with Ramsay patented macerating scrapers, which force the macerating liquid into the blanket of megass, as it is expanding on leaving the rollers, and before it has had an opportunity to absorb air. A recording water meter measures the water used in the maceration process and records not only the total quantity of water passing, but also the rate. With a proper system of maceration, mill speeds, roller settings and grooves, the final juice delivered will contain about 96 per cent. of the total sugar present in the cane. The juice from the crusher and mill No. I., and from mill No. II., passes over a jigging strainer to remove small pieces of broken cane from the juice. The strainer consists of a trough of perforated copper plates carried by spring legs and given an oscillating motion. The broken cane removed by the strainer is discharged at the end of the trough and elevated to a scroll conveyor, which distributes it on to the carrier between mills Nos. II. and III. The juice from mills Nos. III. and IV. is treated similarly in a double jigging strainer before it is pumped back to macerate the megass as it enters mills Nos. II. and III. respectively. The mixed juice is pumped to the juice scales, where it is weighed before entering the juice heaters.

Continental Air Progress.

The commercial development of air transport is more particularly favoured in countries of large areas where aeroplanes can be employed for traffic in conjunction with the railways. This phase of aviation is, at the moment, receiving particular attention in Germany, which, being deprived of the right to construct aircraft for military purposes, has centred its efforts upon commercial flight, with the result that an extensive system of inland air lines is already in operation. Aeroplane builders constitute what is practically a trust that can only depend for its constructional activity upon aid rendered in the form of subsidies by the State and the different municipalities. Such aid is readily forthcoming as part of a national air policy which aims at encouraging the aircraft industry and promoting the training of pilots. In 1925 a sum of eighteen million marks was devoted to the air services. These services are assisted by the municipalities as a means of propaganda and by the State because they are part of a plan for establishing eventually regular passenger services and for serving as "feeders" to international lines. The policy now pursued is to develop the industry, particularly in the direction of standardising machines so that Germany may control aviation in Central Europe. A perfectly organised home air service is regarded as a valuable factor in the creation of international lines, and so great is the vogue of commercial flight that nearly every town has the ambition to be connected up with its neighbours by aeroplanes. The offer of a municipal subsidy is sufficient to prompt the aircraft companies to run a few machines so long as they serve the purpose of local publicity without loss to the organisers. Each new line means additional business to aircraft builders. Some of the lines have an ephemeral existence, but twenty-five services are stated to be in regular operation. Underlying the general plan of organisation is the belief that express passenger traffic will be dealt with eventually by aeroplanes, and that the railway services will thus be simplified and rendered more economical by running trains for ordinary passengers and goods at approximately the same speeds. One of the reasons for the extraordinary activity of the air services is that the Germans work to a definite plan. They have allowed themselves to be carried away by their confidence and enthusiasm, and over-production has placed the aircraft industry in a very criticial situation; but they believe in the final result, which will place Germany in a position to control aviation over the greater part of the Continent.

Of more immediate interest to Germany is the development of international air traffic. Opinion is fairly divided in that country regarding the relative advantage of airships and aeroplanes for very long journeys, and it is probable that both will be tried in the services which it is hoped to organise between Germany and India, South America and other countries. Being debarred, after the Armistice, from constructing airships in Germany, the Zeppelin Company started negotiations five years ago for the building of such craft in Spain, and the seaplane flight from Spain to Argentina last year was a preliminary exploit to prepare the way for a Spanish-German service between Europe and South America. Since then the scheme, developed by Dr. Eckener, of the Zeppelin Company, and by Major Herrera, of the Spanish army, has made such rapid headway that the Spanish Government has signed a decree authorising an air line between Seville and Buenos Ayres. The Government has voted a first subsidy of thirty million pesetas towards the carrying out of the enterprise. Both high-powered seaplanes and airships will be employed and will be navigated under the Spanish flag. The affair will be ostensibly Spanish, as the craft are supposed to be built with Spanish capital in vast factories to be laid down in Spain, but the whole enterprise will be engineered by Germany, and the line will be extended from Seville to Berlin when the new treaty, which comes into operation in July next year, allows German aircraft to pass over French territory. The Zeppelin Company has lost no time in preparing for this new service. It is building for the Seville-Buenos Ayres route an airship known as the LZ 127. It will have a length of 250 m. and a volume of 105,000 cubic metres, and it is expected to carry a paying load of 15 tons. The trials will take place in the autumn of next year between the Spanish coast and the Canary Islands. Italy also believes in the utility of the airship for Transatlantic flight, and proposals are being considered for creating an airship service between that country and Argentina. The routes chosen for these vessels offer certain advantages on account of the regularity of the winds during the greater part of the year. There is now scarcely a country in Europe which is not endeavouring to fall into line with the progress of civil aviation. In Norway a company is being formed under the name of the Nork Aerotransport A.S. with the idea, primarily, of organising a line of all-metal aeroplanes between that country and Great Britain. There is a general impression that we are on the eve of a vast development of air traffic with the aid of machines that will largely extend the scope of economical transport, both home and foreign.

The preparations being made by Germany to play a leading part in the organisation of international air services have stirred the French to renewed efforts to secure a share in the traffic. The geographical position of France certainly offers special facilities for the radiation of a system of air lines. The Mediterranean traces a route to India, the Atlantic ports may put Central Europe into direct air communication with the sea route to North America, while Dakar is a particularly convenient air station for reaching the southern part of the American continent. It is already proposed to compete with the German air service between Seville and Argentina by organising a combined aeroplane and boat service which will effect the journey between Paris and Buenos Ayres in nine to ten days. Aeroplanes will be employed between Paris and Dakar, fast ships will run between Dakar and Natal in Brazil, and aeroplanes will complete the voyage between Natal and Buenos Ayres. As fresh experience is acquired flying machines will be substituted for ships on the sea routes. France has at present five international air lines and others are in project, but it is believed that no real progress can be made except by the creation of an extensive national system which is necessary for the development of the aircraft industry and for the training of pilots. The number of pilots in reserve is steadily diminishing because there is no means of employing them. A committee is now engaged in carrying out active propaganda for the creation of home air lines with the aid of the State, the Departments, the municipalities and the Chambers of Commerce. A beginning has already been made in the Nord, where a service is to be established, and arrangements will shortly be completed for another service in the Limoges district. In each district the service will be adapted to local needs, and when a complete network of air lines has been created they will be organised to serve as feeders for the international lines. It is believed that these local lines are capable of rendering considerable service, especially in the transport of postal and express goods. The light aeroplanes now being constructed are regarded as suitable for this purpose. Machines with engines of 50 or 60 horse-power are capable of carrying small loads at a low cost per mile. With an aeroplane of this type supplies of all kinds have been repeatedly conveyed to the observatory on Mont Blanc.

A service covering the whole country presupposes an organisation of a particularly elaborate character, for every risk must be eliminated as far as possible, and one of the greatest of these is that involved in the high-tension mains which are spreading everywhere with the extension of the rural electrification scheme. How this danger is to be guarded against is a problem that is receiving serious attention. The cables must be rendered visible to the airman in all weathers, and none of the suggestions made to effect this object are satisfactory. There are many difficulties in the way of organising a national air transport scheme, but the French regard this matter as of primary importance, and if confidence in the final result will bring success we may look forward to remarkable developments in air transport in the early future.

Models and Analogies for Demonstrating Electrical Principles.

No. VIII.*

In the Wembley research laboratories of the General Electric Company a plaster relief model† of the electric field in a triode valve has been made, and it is shown in the illustrations Figs. 67–69. The model has been designed to provide an approximate geometrical and kinematical illustration of the electric field existing between the electrodes of an idealised triode valve and the paths of electrons traversing the space between these electrodes under the combined influence of the field and their own inertia. The plan

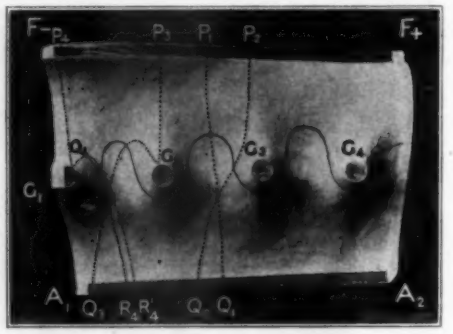


FIG. 67—PLAN VIEW OF VALVE MODEL

view of the model Fig. 67 may be taken to represent a half longitudinal section of a cylindrical triode, the further edge F − F + representing the filament G_1, G_2, G_3, G_4, the cross sections of four grid wires, and the nearer edge A_1 A_2 the longitudinal section of the anode. Distances measured in either of the two horizontal directions from side to side and from rear to front on the model thus represent actual longitudinal and radial distances in the triode; vertical distances in the model have, however, been made to correspond with potential differences. The geometrical resemblance between the model and the triode is thus confined to the plan view.

Heights measured vertically upwards from the horizontal plane through A_1 A_2 represent potential differences negative to the anode. Thus taking the edge F − F + of the model to represent the potential of the filament, the end F − is higher than the end F + by an amount corresponding to the potential difference produced between the ends of the filament by the heating current. The potential of all four grid wires is taken to be that of the centre of the filament; the little flat-topped eminences G_1, G_2, G_3, G_4 are therefore made level with the middle point of the edge F − F +. The general form of the surface of the model will be seen to be roughly that of a heavy sheet

* No. VII. appeared September 24th.

† B. S. Gossling, *Journal* I.E.E., Vol. 58, p. 696, 1920.

of elastic material laid over a pair of rails F − F + and A_1 A_2 and four solid posts G_1, &c., and allowed to sag down in the spaces between. If the surface of the model be regarded as elastic the effects of altering the heights of the posts or rails can readily be imagined, and so a mental picture can be formed of the effect on the field of altering the potential differences between the electrodes.

The paths of electrons starting from various parts of the filament can be followed on the model by releasing small heavy balls from the corresponding points of the edge F − F + and watching them roll down the surface. A ball placed near F + will not, however, roll away, for the slope is against such motion. This expresses the fact that the grid wire G_4 is so much negative to the positive end F + of the filament that the field at the surface of the filament near F + is reversed and no emission is possible. A

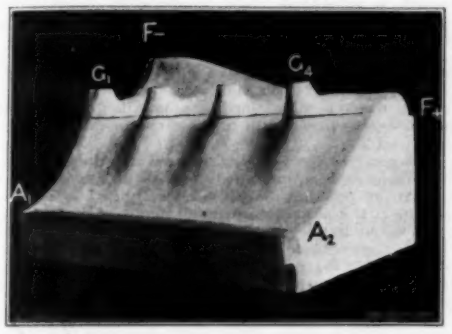


FIG. 68—FRONT VIEW OF VALVE MODEL

particular instance of the effect of the inertia of the electrons is the crossing of two paths such as P_1, Q_1, P_2, Q_2, Fig. 67. These paths cross because in virtue of their inertia the electrons retain the lateral motion acquired during their passage between the grid wires. The lines of force of the field do not cross in any such way. The model also shows how it is that a grid wire usually repels all the electrons approaching it, even although the wire may be at a positive potential with respect to the part of the filament opposite to it. On the model the slope is always against the motion of an electron approaching a grid wire, the downward slopes being in general due to the very low level of the edge A_1 A_2 representing the anode. It is in fact only the electrons which leave the filament in directions such as P_4 Q_4 corresponding very closely with the crests of the ridges connecting G_1, G_2, G_3 with the opposite posts of F − F + that stand any chance of actually impinging on a grid

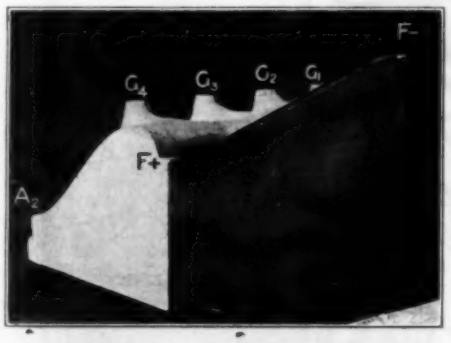


FIG. 69—BACK VIEW OF VALVE MODEL

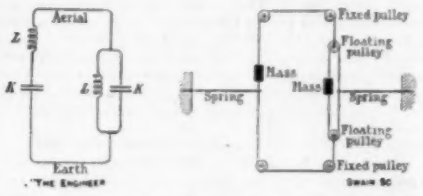
wire, deviations such as P_2, Q_2, P_3, Q_3 being very difficult to avoid.

The model represents a case where the grid current made up of such electrons as P_4 Q_4 would be only about one-thousandth of the anode current; and this can be verified on the model. It will be noted that the electron starting from P_4 is running uphill when it strikes G_1 at Q_4. This is the necessary condition for the production of secondary emission from the grid, for secondary electrons released by the impact are free to leave the grid wire passing to the anode by paths such as Q_4, R_4, Q_4, R_4^1. If there are more secondary electrons than primary a reversal of the grid current demonstrating secondary emission as employed in the "dynatron" will be observed.

The wavy line on the model represents the contour line (or equipotential line of the field) which approximates most closely to the straight line G_1, G_2, G_3, G_4 through the grid wires. The level of this line below the filament can be shown to be $\frac{E\,g + \frac{E\,a}{m}}{1 + \frac{1}{m}}$, where m is the grid screening factor or "amplification constant" of the triode and $E\,g$ and $E\,a$ the respective potential differences between the grid and anode and the part of the filament in question.

The model as shown represents the field determined solely by the shapes and potentials of the various electrodes. When, however, the triode is in normal operation this field is modified in certain regions by the presence of dense concentrations of slowly moving electrons constituting a "space charge." This "space charge" is normally situated only in the immediate neighbourhood of the filament and its effect on the field is indicated by the broken line between F − and G_1 on the left-hand side of Fig. 68. As is well known, the effect of the space charge when fully developed is to reduce the field immediately outside the filament just to a zero value. The broken line is therefore shown becoming horizontal as it approaches F −.

A dynamic model of tuned electrical circuits was described in a paper read by Professor C. F. Jenkin before the Wireless Section of the Institution of Electrical Engineers on June 7th, 1922. When commencing to deal with wireless circuits the author found it difficult to realise the effects of each part of a complex circuit made up of the aerial and tuning inductance and capacity, and in particular the effect of changing the coupling of the inductance and the capacity from series to parallel. He therefore decided to make a dynamical model to represent the circuit. The essential feature of such a model was considered to be that the mathematical equations for the motions of the various parts should be the same as those for the electrical circuit, and it was



FIGS. 70 & 71—ELECTRICAL CIRCUIT AND DYNAMIC MODEL

also considered desirable that the appearance of the model should resemble that of the electrical circuit so that its motion might appear analogous to the behaviour of the electrical circuit. To make the mathematical equations the same inductances were represented by masses, capacities by springs, and resistances by friction, assumed to be proportional to velocity.

The electrical circuit is shown in Fig. 70, where the aerial is represented conventionally as an inductance in series with a capacity to earth. In the dynamic model—Fig. 71—the inductances are represented by masses, the capacities by cantilever steel springs, and the electric circuit by a circuit of string. The inductances may be varied by increasing or decreasing the masses, while the capacities may be varied by increasing or decreasing the length of the springs, which are fixed between wedges which may be put in at any point in their length.

Quantities of electricity expressed in coulombs are represented by lengths of string, currents by the velocity of the string, and voltages by forces. Thus the voltage across a condenser is represented by the difference of the tension of the string above and below the spring, and the charge by the deflection of the spring. When the tuning condensers are connected in parallel, the corresponding mass and spring are connected side by side, whilst when, on the other hand, the tuning condenser and reactance are connected in series, the mass and spring are connected in series, although a more simple change which has the same effect is produced by inserting a wedge for the purpose of jamming one of the floating pulleys.

The behaviour of the model can be most easily followed by taking a few simple examples. Telephone engineers are familiar with the use of inductances and capacities in parallel for separating low-frequency currents from high-frequency currents. If the tuning capacity and inductance be connected in parallel—as in Fig. 70—on the application of a low-frequency "E.M.F." produced by moving the left-hand spring slowly the whole "current" will flow through the "coil," for the right-hand spring does not deflect. On applying a high frequency, however, the whole current flows through the "condenser," the right-hand mass being almost still. On slowly reducing the frequency until the resonating periodicity is reached, violent motion of the mass and spring results, with scarcely any perceptible motion of the string representing the aerial. No current can flow in the aerial because a tuned circuit blocks the way, and this experiment illustrates the use of a tuned inductance for coupling two valves, there being a high potential difference—*i.e.*, string tension—across the combination.

Considering the model as a whole, a few trials show that it has a natural period, which it will maintain, the amplitude being gradually reduced by friction. The natural period may be found from the equation

$$p^2 \left\{ \frac{L^1}{K^1} + \frac{L}{K^1} + \frac{L^1}{K} \right\} - L\,L^1\,p^4 - \frac{1}{K\,K^1} = 0$$

where L L^1 are inductances or masses, K K^1 capacities

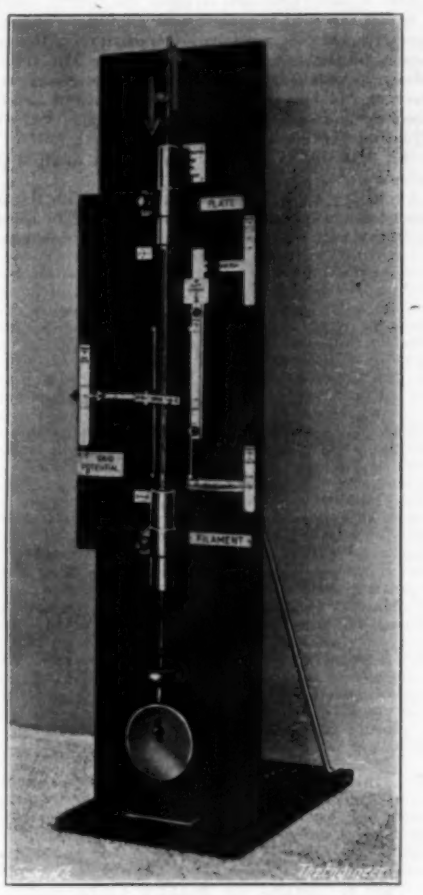


FIG. 72—BLAKE'S VALVE MODEL

or deflections of springs per unit force, and $p = 2\,\pi \sim = 2\,\pi/T$, where T represents periodic time. This is a quadratic in p^2 and there are two natural periods. After a few trials the second natural period was found. With one natural periodicity the springs move up and down together, whilst with the other they move in opposite ways. If the pulleys be wedged so that the mass is attached to the spring, to produce the effect of the inductance and capacity in series, there is again a natural period of vibration, which may be timed and compared with

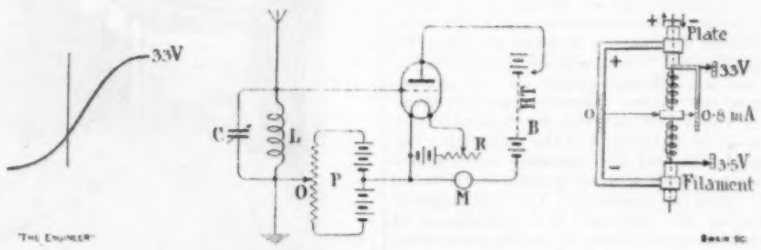


FIG. 73—VALVE CIRCUIT AND VALVE MODEL

the former two. In this case both masses and both springs have the same motion, and the period is the same as that calculated for a single spring with a stiffness equal to the sum of the stiffnesses of the two and a mass equal to the sum of the two masses, or a single condenser of elastance equal to the sum of the elastances of the two and a single inductance equal to the sum of the two inductances.

To represent a Post Office aerial, the aerial spring must be made very short and its mass small. To tune circuits to large wave lengths a large loading mass is required, and the natural period then becomes practically independant of the aerial capacity and inductance.

Mr. Blake's model, to which we referred last week—see Fig. 72—was designed for demonstrating the principle of a three-electrode receiving valve, and it is used for instruction purposes in the Royal Air Force. In the circuit shown in Fig. 73 there are four variable factors:—(1) The grid

potential which can be varied by the potentiometer O; (2) the filament potential which can be varied by the resistance R; (3) the plate voltage which can be varied by the high-tension battery B; and (4) the oscillations produced by the incoming waves in the aerial circuits C L, which vary the grid potential. A milliammeter M is shown in the plate circuit.

A drawing of the mechanical model is shown in Fig. 74, where the spring V is employed to represent the plate current. In the centre of the spring, and attached to it, is a metal disc G, which represents the grid potential of the valve, whilst on the left there is a scale on which the grid voltages are indicated, a pointer P being provided to show the correct position in which the grid potential disc should be placed to represent various negative or positive values with respect to the filament of the valve. The filament voltage is varied by more or less compression on the lower end of the spring and the variations are indicated on the scale. The plate voltage is varied by adjusting the compression of the upper half of the spring and the voltages are indicated upon a plate voltage scale.

A fourth scale S is also provided on which the plate current can also be read in milliampères. The received oscillations are represented by the up and down move-

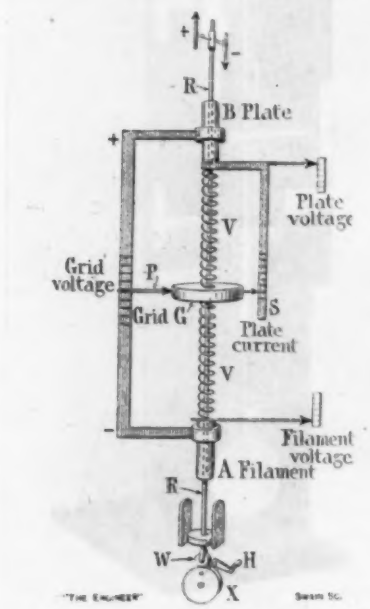


FIG. 74—DETAILS OF BLAKE'S VALVE MODEL

ments of a metal rod R, which passes through the centre of the spring V and is coupled to the grid voltage disc G by an adjustable slipping contact at the centre of the disc through which it passes. The oscillations are obtained by means of an excentric X below the rod, which is turned by means of a handle H, the excentric being adjustable in order to demonstrate the effect of alterations in amplitude. Two painted arrows, red and white, at the top of the rod indicate the phase. All movements of the grid disc above zero on the grid potential scale represent positive grid potential, whilst those below represent negative potential. Referring again to Fig. 73, the effect of alteration of any of the factors (1), (2) and (3) in the valve circuit can be shown on the plate current, both with the aerial quiescent or when influenced by incoming oscillations, and the action of the valve can be observed when used for amplifying or when rectifying at different points on the characteristic curve of the valve. Moreover, the amplification factor of the valve can also be demonstrated. Three volts positive on the grid of the valve when the plate voltage is 33 and the filament voltage 3·5 results in the top of the characteristic curve being reached and gives a reading of 1·5 milliampère. With the grid of the valve at zero an increase of 21 volts on the plate, making 54 volts in all, gives, when employing the same filament voltage, the same reading, viz., 1·5 milliampères, the amplication factor being 7. The values of the scales and the curves represented by the model shown at the meeting of the Institution of Electrical Engineers at which the paper on Mr. Clinker's model was read, were from a French R valve, but the Royal Air Force has worked out similar scales and curves to suit the various types of valves which it employs, and these scales are easily interchanged.

When considering the action of the model it is useful to note that an increase of filament current increases the density of the spring coils, and makes it impossible for the negative phase of the oscillations to affect the grid potential disc, and this can be likened to an increase of electrons from the filament of the valve when its temperature is increasing and creating a space charge.

The broadcasting station in Vienna will celebrate its third anniversary on October 1st, when a special programme is being given.

The Narrows Power Plant of the Virginian Railway Company.

No. II.*

Turbo-generators.—Four main units have been installed, each of 10,000 kilowatts capacity, 25 cycles, three-phase, 11,000 volts, having direct connected exciters. One 300-kilowatt auxiliary turbo-generator is provided.

The main turbines are of the parallel flow type, operating at 1500 revolutions per minute at 275 lb. steam pressure, and 150 deg. superheat at the throttle. They are guaranteed for a maximum economy of 12.48 lb. of steam per hour, when delivering 10,000 kilowatts at 80 per cent. power factor, and with a vacuum of 29in. These turbines are connected through a pin type flexible coupling to the generators, each of which is designed for a continuous full load rating of 12,500 kilovolt-ampères at 80 per cent. power factor, and will carry, following continuous full-load operation, a load of 15,000 kilovolt-ampères at 80 per cent. power factor for one hour, and 18,750 kilovolt-ampères at 80 per cent. power factor for five minutes following the operation at 15,000 kilovolt-ampères, without exceeding a safe operating temperature. A 125-kilowatt, 250-volt direct-connected exciter is mounted at the end of each generator.

The 300-kilowatt turbine is of the impulse type, and is direct-connected through a reducing gear to a three-phase, 440-volt, alternating-current generator; a 100-kilowatt, 250-volt direct-current generator; and a small direct-current generator supplying excitation to the alternating-current machine. The 440-volt alternating-current generator supplied power for the operation of the auxiliary equipment during the starting up of the power plant, and is available for special service during regular operation. The 100-kilowatt direct-current generator is provided to supply excitation to any one of the main units in the event of failure of the direct-connected exciters furnished with them.

Turbo-generator Ventilation.—78,000 cubic feet of air per minute are required for the ventilation of each of the generators. This volume is supplied by vanes on the rotors, which draw the air from the outside through louvres at the east and west ends of the turbine-room, and a masonry air duct, in which air filters of the oil-impregnated type are fitted. The air discharges into ducts leading into the boiler-room directly behind the boilers, thus furnishing heated air to the boilers.

Condensing Plant.—Each turbine has a surface condenser, with circulating water pump, a two-stage air ejector, and a condensate pump. The condensers are of the two pass type, and each has an effective cooling surface of 20,000 square feet. The condensers are suspended from the turbine foundations, with a copper expansion joint at the exhaust steam passage from the turbine, and a heavy cast iron breeching extending from the bottom of the expansion joint to the top of the condenser; 20,000 gallons of water per minute are required for the operation of the condensers, and each condenser has a centrifugal condensate pump with a capacity of 300,000 lb. of water per hour against a total head of 135ft.

Air is removed from the condensing system by means of two-stage air ejectors—three ejectors being provided for each pair of turbo-generator units—so arranged that either of the three ejectors may be used on either turbine unit. These ejectors use the condensate from the condensers for a condensing medium, and are each of ample capacity for removing the air from the systems when operating at a vacuum of 28in. to 29in.

Each condenser has a priming ejector, and the flange nozzles on the large breeching connections are provided with relief valves, the discharges of which are carried through the roof of the boiler-room.

Feed-water System.—The feed-water system comprises bleeder heaters at each of the turbines, two open water heaters, three turbine-driven boiler feed pumps, and a loop system of boiler feed piping between the pumps and the boilers. The bleeder heaters are of the closed type, each being capable of heating approximately 200,000 lb. per hour through a temperature range of 100 deg. The steam condensed in the bleeder heaters is handled by three 100 gallons per minute centrifugal condensate pumps. The condensate is drawn from the condensers by the condensate pumps and passed progressively through the air ejectors and the bleeder heaters, and together with that from the bleeder condensate pumps discharges either into the open feed-water heaters or into a tank. This tank is subdivided by a partition into a treated water storage tank and a surge tank. The surge tank provides for the storage of the condensate resulting from a 20,000-kilowatt load for a period of five minutes, even if no water is fed to the boilers. The storage tank supplies the make-up water required for the system, and, when full, it will handle a swing of 22,200 kilowatts for four and one-half minutes, even if no condensate from the condensers is available. A float valve allows the admission of make-up water to the storage tank through a water-softening plant.

Two open feed-water heaters are provided, each having a capacity for passing and heating 250,000 lb. of water per hour to a temperature of 225 deg., and each capable of passing 700,000 lb. per hour, heating this amount through a somewhat lower temperature range. This capacity will allow the operation of four boilers at 384 per cent. of rating.

The three boiler feed pumps each have a capacity of 650 gallons per minute against 800ft. head, and will each handle a load of 24,000 kilowatts. The temperature of the feed water is maintained at approximately 225 deg., and an excess pressure of about 20 lb. is carried on the boiler feed lines.

High-pressure Steam Piping.—Three high-pressure steam systems have been provided, one furnishing steam at boiler drum pressure (350 lb.) and saturated steam temperature; the second furnishing steam at boiler drum pressure and 150 deg. superheat, the total temperature of which is approximately 580 deg.; and the third furnishing steam at 175 lb. pressure and 180 deg. of superheat, the total temperature of which is approximately the same as the high-pressure superheated steam.

There are drip pockets of large capacity at all changes of direction and at other places where water might collect. Steam traps of the tilting type take the drips from the drip tanks and discharge through check valves to a common header which terminates in the open feed-water heaters.

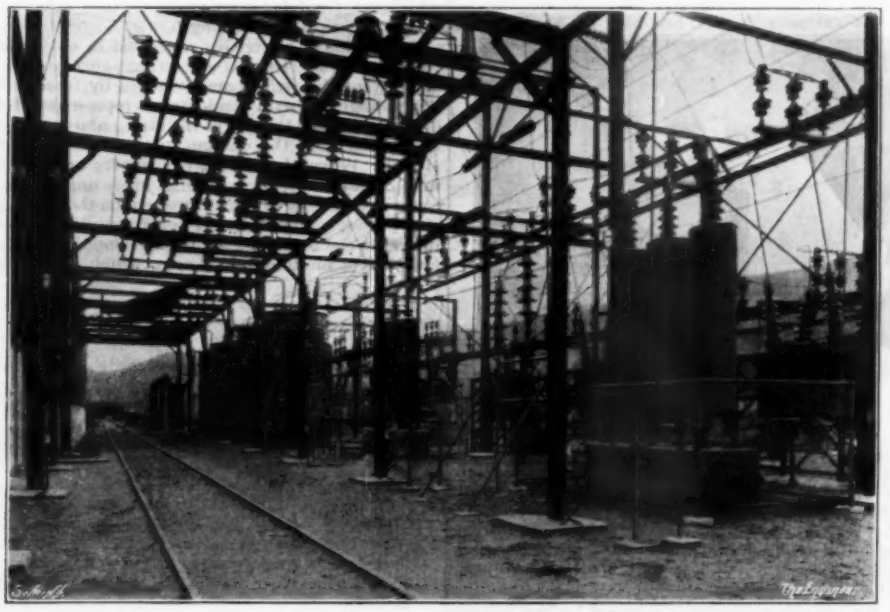
Boiler Blow-down System.—There are blow-off valves at both ends of each boiler connected to a header which discharges into a blow-off tank. A vent leads from the blow-off tank through the roof and terminates in an exhaust head designed to prevent emission of water from the line. The discharge line from the blow-off tank is carried under ground to the river.

A vacuum cleaning system, with outlets throughout the boiler-room so distributed that all parts of the room may be kept clean and free from any coal dust which may leak from the pulverised fuel system, is provided.

Switching and Electrical Connections.

One phase of each generator is connected to the primary of a 10,000-kilovolt-ampère, single-phase, 9900/88,000-volt, water-cooled transformer. The connections are arranged for normally operating each generator and corresponding step-up transformer as a unit. A three-phase 11,000-volt bus is provided for synchronising and for supplying power to the station auxiliary transformers, and is connected through oil circuit breakers to connection points between each generator, and its corresponding step-up transformer. Each generator can be isolated by a set of knife switches, and a horn gap switch is provided on the primary side of each transformer, capable of breaking the magnetising current of a transformer. This arrangement makes it possible to operate a generator when the corresponding step-up transformer is out of service for inspection or repairs, and allows the operation of the maximum number of transformers, in order thereby to keep the step-up impedance low, at times when economical operation dictates the use of a smaller number of generators.

Each step-up transformer is connected on the secondary side, through an oil circuit breaker to the 88-kilovolt bus, which is divided into two sections by a switch, with two step-up transformers connected to each section. The two west transmission lines are connected through oil



STEP-UP STATION

* No. I. appeared September 24th.

circuit breakers, one to each section of the 88-kilovolt bus, and the two east transmission lines are similarly connected. The middle point of each 88-kilovolt transformer coil is connected through a disconnecting switch and neutral bus, to a neutral ground resistance.

The arrangement of bus sections is such that with any 11-kilovolt bus section and the corresponding 88-kilovolt bus section out of service, it is still possible to keep in operation two generators, two step-up transformers, two auxiliary transformers, one step-down transformer of the Narrows step-down sub-station, the water rheostat installation—hereinafter described—and one transmission line. Or the same amount of apparatus may be kept in normal operation while one generator, through separate bus sections, is used independently to energise one transmission line for test purpose.

From the generator terminals insulated copper cables run in fibre ducts to the current and potential transformer room, where connection is made to copper bars which, in turn, are connected to insulated lead-covered copper cables which lead to the step-up transformers. From the above-mentioned copper bars, connections are carried up through the floor to the 11,000-volt oil circuit breakers. From these breakers, connections are carried down into the current and potential transformer room, and up to the 11,000-volt bus.

440-VOLT AUXILIARY POWER BUS AND OIL CIRCUIT BREAKERS

Electrical Operating Gallery.—The electrical operating gallery contains the generator and exciter field rheostats, exciter, field and regulator board, main control instrument and relay board, auxiliary power control instrument and relay board (vertical) battery, charging and control power panels, lighting panels, graphic wattmeter panel, and temperature indicating and transformer alarm panel. A small balcony projecting into the turbine-room allows a view of the turbine-room to be obtained, and provides space for the power director's desk in front of the control bench board. The main control and instruments are arranged on seven desk and vertical panels facing north, and the main relays and watthour meters on seven corresponding vertical panels facing south, the space between the rears of the two boards providing access to wiring and being closed off by doors.

Each generator has mounted on the shaft a 125 kilovolt, 250-volt exciter. A 100-kilowatt, 250-volt spare exciter is mounted on the same shaft with a 300-kilowatt, 80 per cent. power factor, 25-cycle, three-phase, 440-volt generator and driven by the 300-kilowatt steam turbine. The field, exciter and regulator board includes one field and exciter panel and one voltage regulator panel for each generator and one panel for the spare exciter. A 250-volt bus allows the spare exciter to be used to supply field current to any generator in case the direct-connected exciter is out of service. The generator field switches are electrically operated from the main control bench board. A rheostatic type voltage regulator is provided for each generator and regulates the generator voltage by cutting the generator field resistance in or out by means of a motor-operated field rheostat. Each generator is independently regulated by a separate regulator, the regulator receiving potential from a generator potential transformer connected across the traction phase. The regulators are compensated to give a dropping characteristic with increase in generator wattless current, thereby insuring parallel operation, and to give a rising characteristic with increase of watted component of generator current, thereby compensation for drop due to step-up transformer impedance and for part of the transmission line drop. The compensation current connections are from current transformers in the generator leads.

The control power for the circuit breakers is at 220 volts pressure, and is obtained from a storage battery which is charged by two motor generator sets, one of which is kept floating on the buses at all times, keeping the battery fully charged. A feeder panel contains twelve fused knife switches, arranged so as to sectionalise the supply of control power, that any fault in the control system may be isolated without any interruption to any essential service.

Auxiliary Power.—The three auxiliary transformers are connected to the 11,000-volt bus through three oil circuit breakers, and are each designed for 1200 kilovolt-ampères, 11,000/440-volt, three-phase. The entire load can be carried by two transformers, leaving the third in reserve. A further source of auxiliary power is the 300-kilowatt, 440-volt, three-phase, turbine-driven generator previously described. Solenoid operated oil circuit breakers—see illustration—are used for connecting the auxiliary transformers to the 440-volt bus, and also for the 440-volt feeders.

Since the available short-circuit current from two of the auxiliary transformers is greater than can be safely ruptured by the usual industrial motor-starting equipment, the circuit breakers at the 440-volt bus are depended upon for protection against short circuit. In most cases a single circuit breaker feeds only a single motor, or two motors which must be operated or shut down together. Across the line starting is employed generally, the circuit breaker being closed or opened by push button control located at the motor. Circuit breakers having push-button control cannot be closed from the electrical operating gallery, but all circuit breakers may be opened and locked open from the electrical operating gallery.

For starting equipment with holding coils direct current is used for the coils in order to prevent the opening of equipment of inadequate rupturing capacity due to low voltage at time of short circuit.

The circuit breakers are opened automatically by over-current relays with definite and inverse time limit characteristic.

Protective Features.

The 11-kilovolt circuit breakers and the 88-kilovolt transformer oil circuit breakers are not automatic on overload. Protection against internal fault in any generator or transformer of 1200 kilovolt-ampères and larger, is accomplished by differentially connected current transformers and over-current relays. In case of internal faults in a generator or step-up transformer the connections are such as to open simultaneously the generator 11,000-volt oil circuit breaker, the generator field circuit breaker, and the transformer 88-kilovolt oil circuit breaker. An internal fault on one of the 1200 kilovolt-ampère transformers will open simultaneously the 440-volt and the 11,000-volt auxiliary transformer circuit breakers. An internal fault on one of the 3750 kilovolt-ampère step-down transformers will simultaneously open the tie circuit breaker and the 88-kilovolt circuit breaker connected to that transformer.

A 220-ohm resistance connected between the step-up transformer neutral bus and earth limits to 200 ampères maximum the current in case of an earthed transmission line. Each 88-kilovolt transmission line oil circuit breaker is opened automatically in case of an earth on its line by a low energy over-current relay so connected in the current transformer secondary circuits as to receive current only in case of an earth. Over-current relays open the 88-kilovolt transmission line circuit breakers in case of transmission line short circuit.

The water rheostat circuit breakers and the 88-kilovolt circuit breakers feeding the step-down station have short-circuit protection by over-current relays.

Excessive temperature, failure of water supply, or pressure relief diaphragm failure on any transformer will ring a bell on the electrical operating gallery and operate an annunciator drop, indicating which transformer is involved.

Outdoor Transformer and Switching Station.

The outdoor transformer and switching station includes auxiliary and lighting transformers, main step-up transformers, and the 88-kilovolt transmission line lightning arresters. It also includes the step-down transformers for feeding the trolley at Narrows. The 88-kilovolt circuit breakers are all 400 ampères two-pole solenoid operated. Disc insulators and copper cable are used for buses and most connections. Copper tubing is used for the step-up transformer connections in order to obtain rigidity. The 11,000-volt transformer connections from the power plant are, for the step-up transformers, lead-covered single-conductor varnished cloth insulated cables run in concrete protected fibre ducts, and for the auxiliary transformers three-conductor lead-covered varnished cloth insulated cables run in steel conduit.

The disconnecting switches used for isolating the tie circuit breakers and water rheostat circuit breakers are of the underhung hook-stick operated type. All other outdoor disconnecting switches are upright mounted, mechanically operated through bell cranks, rods and handle at ground level. The 88-kilovolt switches are horizontal opening, double break, and the other mechanically operated switches are vertical opening, single break. Disconnecting switches which may have to break transformer magnetising current are provided with horn gaps, and all horn gap switches are placed above adjacent apparatus and connections in order to avoid short circuits from gases produced by arcs.

Two 88-kilovolt electrolytic lightning arresters are provided, one for the two west transmission lines and one for the two east lines; each arrester consists of three tanks, transfer switch, impulse gaps and two sets of horn gaps, one set for each transmission line.

The four main step-up transformers are designed for 10,000 kilovolt-ampères, 9800 to 88,000 volts, 25-cycle, single-phase, oil-insulated, water-cooled. An additional full capacity tap gives a ratio of 9310 to 88,000 volts. The transformers are designed to carry 200 per cent. load for five minutes following 150 per cent. load for one hour without exceeding safe temperature, and will withstand without damage a short circuit on the secondary terminals with normal voltage maintained on the primary terminals, providing the duration of the short circuit is not sufficient to cause injurious heating. Each transformer has an inherent reactance of approximately 8 per cent. at normal rating.

The station auxiliary transformers are each designed for 1200 kilovolt-ampères, three-phase, 25-cycle, 11,000/440 volts, oil insulated, water cooled. The primary winding is provided with eight additional full-capacity taps ranging in 2½ per cent. steps above and below 11,000 volts. Connections are star on the 11,000-volt side and delta on the 440-volt side. These transformers are designed to withstand without damage a short circuit on the secondary terminals with normal voltage maintained on the primary terminals, providing the duration is not sufficient to cause injurious heating. Each transformer has an inherent reactance of approximately 12·2 per cent. at normal rating.

Each of the water-cooled transformer is equipped with a water flow indicator with loss of flow alarm contact, a dial indicating thermometer with excess temperature alarm contact, and a pressure relief diaphragm with target indicator and alarm contact. Oil pumping and filtering is provided for by a motor-driven blotting paper type filter press.

Regeneration.—The electric locomotives used are of the split-phase type in which the 12,000-volt single-phase power from the trolley is stepped down through a transformer on the locomotive and converted to three-phase for the traction motors by means of a synchronous-phase converter. This type of locomotive provides automatic change from motoring to regeneration, as the gradient changes, without action of the engineman other than a movement of a lever operating the transformer balancing switch. The regenerated power is returned to the sub-stations and finally to the Narrows power plant, where excess power is absorbed by a water rheostat consisting of electrodes immersed in the river.

General.—The electrical apparatus was furnished by the Westinghouse Electric and Manufacturing Company as a part of its general contract for apparatus for electrification of the railway. The boilers were built by the Springfield Boiler Company, and the pulverised fuel plant by the Combustion Engineering Corporation. The turbines and generators were supplied by the Westinghouse Electric and Manufacturing Company.

The Junior Institution of Engineers.—The Awards Committee of the Institution has recommended, and the Council has accepted, that the medals and other awards for the past session be allocated as follows:—The Institution Gold Medal to Mr. J. Wolstenholme for his paper, "The Commercial Side of Foundry Work;" the Vickers' Gold Medal and Prize to Mr. A. N. Moon for his paper, "Comfort in Railway Travel from the Point of View of the Engineer;" the Institution Silver Medal to Mr. E. le L. Lamb for his paper, "Electricity in Mining;" the Silver Medal for the Sheffield Section to Mr. E. C. Snelgrove for his paper, "The Treatment of Water for the Use of Municipalities;" the Silver Medal for the Midland Section to Mr. G. H. Willett for his paper, "Pipe Work—its Manufacture and Lay-out;" the Silver Medal for the North-Western Section to Mr. G. H. Ayres for his paper, "Roller Bearings, with Particular Reference to Taper Roller Bearings;" the Silver Medal for the North-Eastern Section to Mr. J. W. Palmer for his paper, "Design of Jigs and Fixtures;" the Durham Bursary to Mr. W. A. Sallis for his paper, "The Strowger System of Automatic Telephony;" Past Secretary Dunn Medal for informal lecturettes to Mr. F. W. Webb for his lecturette, "Paint Spraying."

Institution of Engineers and Shipbuilders in Scotland.—The programme for the winter session of the Institution of Engineers and Shipbuilders in Scotland includes the following papers:—"Large-grained Steel Wire and a Comparison with Rope Wire," by Dr. E. M. Horsburgh; "Steam *versus* Diesel Machinery for Cargo Vessels," by W. G. Cleghorn; "Diesel Engines," by Mr. D. M. Shannon; "A Stability Chart for the Use of Shipmasters and Officers," by Dr. A. M. Robb; "The Clock Mechanisms for the Great Bell of the University of Bristol," by Professor Dr. David Robertson; "High Elastic Limit Steel for Shipbuilding and Marine Engine Work," by T. M. Service; "The Application of Double-acting Diesel Engines for Ship Propulsion," by Mr. Robert Love; "The Development of Industrial Welfare Work," by the Rev. Robert R. Hyde; "Manœuvring of Ships: Part III., Unbalanced Rudders of Single-screw Ships; Effect of Fullness of Form," by Mr. G. H. Bottomley; "Advantage of Pre-cooling by Primary Evaporation," by Mr. Henry Brier; "Efficient Methods of Shipyard and Workshop Lighting," by W. J. Jones; "Pulverised Fuel," by Mr. R. Jackson; "Latest Development in Underfeed Stoker Practice in the United States," by Mr. J. G. Worker. The president of the Institution for the forthcoming session is Mr. A. J. Campbell, of William Beardmore and Co., Ltd., Dalmuir. The opening meeting will be held on the evening of Tuesday, October 5th, at the home of the Institution, Elmbank-crescent, Glasgow.

The Scapa Flow Salvage Operations.

The very successful salvage operations which have been carried out by Cox and Danks, Ltd., of 168, Regent-street, London, in connection with the raising of the scuttled German fleet at Scapa Flow, have already been referred to and illustrated in The Engineer in our issues of January 2nd and September 4th, 1925. In a period which extended from July of that year until early last May, twenty-five small and large destroyers were raised and dealt with. Many of these boats were sold to shipbreaking firms, whilst others were dismantled and broken up by the salvagers' own shipbreaking department at Lyness Pier, Orkney Islands. At the present time only a few bare hulls of these ships are to be seen in the adjoining Mill Bay, and these, we understand, will be broken up during the coming winter season.

With the completion of the first part of its salvage programme early in 1926, the firm turned its attention to the more difficult problems involved in the refloating of the larger ships. It will be recalled that about November, 1923, Cox and Danks, Ltd., purchased from the Admiralty the wrecks of the Hindenburg, Moltke, Seydlitz and other ships, along with the destroyers already raised. Early in May, a thorough survey of the battle-cruiser Hindenburg was made by the firm's diving staff, and a scheme was worked out for lifting her. A few weeks ago, by the courtesy of Mr. E. F. Cox, we were invited to visit Scapa Flow and to inspect the salvage arrangements for raising that vessel. Before describing them and outlining the work of the present season, some detailed particulars of the sunken battle-cruiser may perhaps be given, as the work on her has occupied most of the summer and has only been deferred on account of the failure of two water-tube boilers—thus cutting off a large portion of the pumping power—and the uncertain weather of the autumn season at the Orkney Islands. Work upon the ship will be resumed, we understand, in the early spring.

The Battle-Cruiser Hindenburg.

The Hindenburg is a sister ship of the battle-cruiser Derfflinger, which was so heavily injured in the Battle of Jutland. The ship has a normal displacement of about 28,000 tons, with a water-line length of approximately 700ft., a beam of about 96ft., and a mean draught of 27ft. She is flush-decked from end to end, with a big sheer to her bows. Her superstructure is, in general, high, and there is a forward tripod mast which has a stump top-mast and three heavy tops. Two derricks abeam of the fore funnel are also fitted. Her main armament comprises eight 12in. guns and fourteen 5·9in. guns, with anti-aircraft guns and submerged torpedo tubes. Amidships, the flat upper deck is provided with 4in. armoured protection against aerial attack. The main protection comprises 12in. side armour amidships, which diminishes to 4in. at the ends of the ship. The turrets and barbettes have 7¾in. and 10½in. armour respectively.

The Hindenburg was constructed at the Wilhelmshaven Dockyard, and work on her was begun in July, 1913, but she was not finished until about the middle of 1917, and did not take part in the Battle of Jutland. Her propelling machinery comprises quadruple screw "Marine type" turbines, approximating to 63,000 horse-power. The official speed of the ship was given as 26½ knots, but she was probably faster. Eighteen Schulz-Thornycroft boilers provided steam, and were designed both for coal and oil burning.

The ship, as scuttled, lies off the Island of Cava to the west of Scapa Flow, in a position approximately north and south, in about 11½ fathoms of water. She was, we understand, towed to this position, whilst in a sinking condition, with the object of preventing her, if possible, from becoming completely submerged. In the position in which she sank the boat deck is just awash at low spring tides, whilst at ordinary times the jackstaff is just about covered, and there is nearly 28ft. of water over the after quarter deck. These levels are to be largely accounted for by the natural sheer of the ship.

The Salvage Plans.

Various plans for refloating the ship were investigated. They included a project for raising the wreck by means of air-filled pontoons, and also a scheme submitted by a firm of German salvage engineers for freezing up the deck apertures and then expelling the imprisoned water by compressed air. Both these plans were, after consideration, rejected in favour of the firm's own scheme for sealing up all the deck and ship side openings, outboard valves, &c., and reclaiming the ship intact by means of direct pumping.

The carrying out of such an extensive salvage operation naturally involved the provision of suitable floating bases, with power, lighting, compressed air, oxygen and acetylene gas, and other necessary services. Fortunately, these were in part already to hand. It will be remembered that in order to raise the torpedo destroyers, Messrs. Cox and Danks made use of a part of the large submarine repair dock which was delivered up by Germany under the Peace Treaty. The centre section of that dock was removed, and it was transformed into two floating pontoons fitted with hand-operated winch gear. The side walls of the dock were, however, retained, and the pontoons so provided, as indicated by the two views reproduced on page 362, afforded excellent office, store and power plant accommodation. Two further pontoons were added later. Like the first two, they were also sections of a large floating dock, and one of them was described in detail in our issue of September 4th, 1925. These larger pontoons are each equipped with boilers and steam and oil engine driven power plant, and a large space is also available on them for joiners', shipwrights', engineers', and blacksmiths' workshops. These four pontoons were moored alongside the wreck. Access to the above-water decks of the Hindenburg was during the operations given by two suspension bridges with adjustable cables, which were formed of planks laid upon the wire ropes. In order to shield the wreck from northerly winds, two destroyer hulls, which will be seen in the background of Fig. 4, page 362, were moored to the north of the wreck, and formed a breakwater, giving a protected area for the diving operations. In the mooring of the pontoons referred to, good use was made of the ships' anchors. They include two 9-ton and five 7½-ton anchors, as well as several 4 and 3½-ton anchors. They were disposed in a suitable manner around the area of operations, and use was also made of the 19,000-ton sunken hull of the Von der Tann, which afforded an excellent holdfast for one of the pontoons.

The main work of getting the first pontoon into position was begun early in March of the present year, and by the middle of that month it was possible to begin the patching of all the deck and side openings. This operation was started at the forward end of the ship and continued in the direction of amidships. By about the middle of that month, some fourteen divers were constantly employed on this work. The patches varied in size from small plugs of only a few inches in diameter up to the largest patch which had an area of 760 square feet, and they numbered over 700. It was necessary to cover a deck aperture of about 38ft. by 20ft., which was left when the damaged after-funnel of the ship was removed. This

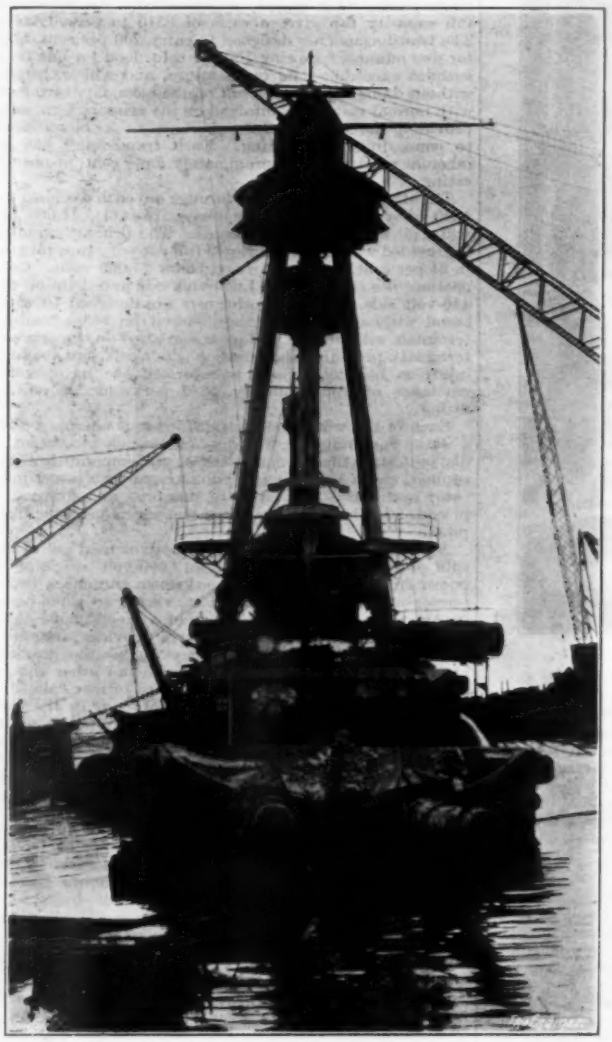


FIG. 1—BOW VIEW OF SHIP WHEN RISING

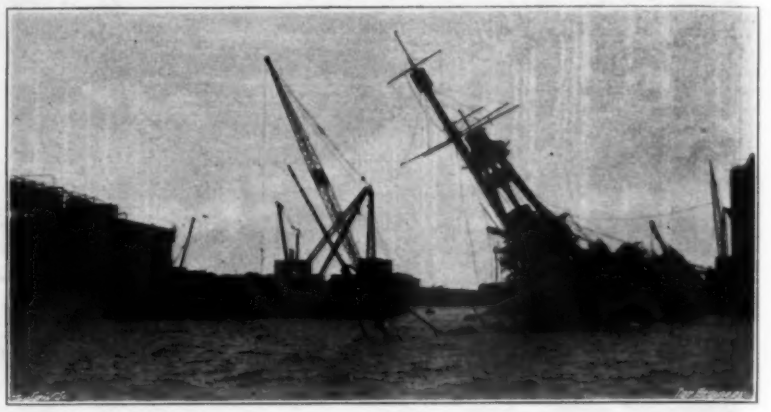


FIG. 2—THE HINDENBURG APPROACHING CONDITION OF MAXIMUM LIST

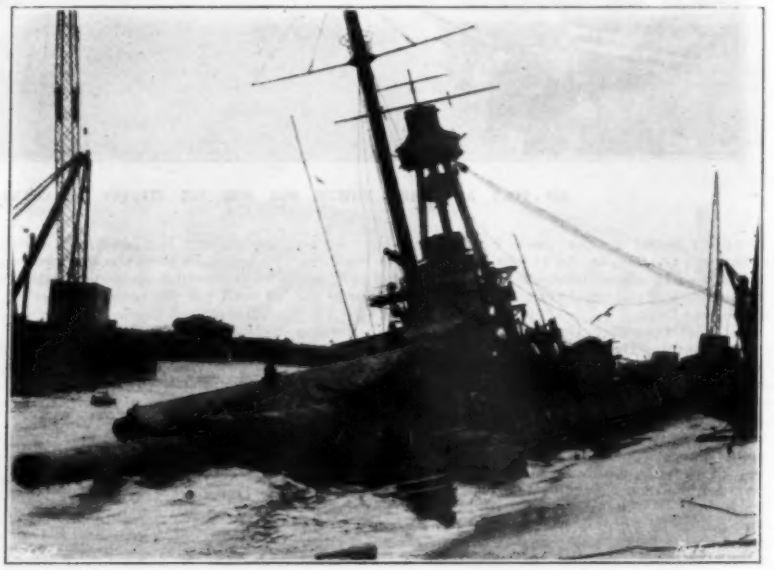


FIG. 3—VIEW FROM STERN SHOWING THE SHIP PARTLY RAISED

funnel, which was half-cased, was so badly holed by corrosion that its complete removal by oxy-acetylene burning was necessary before a water-tight joint could be made.

In the early stages of the work operations were somewhat delayed by uncertainty as to the exact subdivision of the ship. It was therefore decided to search likely places in the ship for information on this matter and the disposition of the various flooding valves. After three days of search by divers, an almost complete set of ship's plans, including piping and flooding plans, was discovered in the lower control rooms. It is worthy of mention that a number of these plans, including those of the flooding arrangements—we have had the privilege of personally inspecting and handling them—were engraved upon non-ferrous sheet metal in a manner which rendered them practically indestructible. As was to be expected, some of the instructions were rendered illegible by incrustations formed during nearly seven years' immersion in salt water; but they were, nevertheless, useful. After careful comparison and study, the plans were re-drawn in a drawing-office on site, and the instructions and directions translated. With this additional valuable information at the firm's disposal, the work of salving was simplified to a great extent, and more rapid progress was made possible.

In particular, the flooding valves—the exact position of which had been till then unknown—were located, and they were closed systematically by divers who worked inside the ship by the aid of powerful submarine lamps. We may mention that the supply of air for the divers and current for the underwater lamps was assured from two independent installations, one on the pontoons, and a supplementary installation on one of the upper decks of the Hindenburg herself. The work of patching and sealing the various openings occupied close upon five months. In most cases, other than those where wooden plugs could be conveniently employed, specially built-up wooden patches had to be constructed, and according to the position and size of the patch, wood planks varying in thickness from 1in. up to 6in. were employed. Some patches are visible immediately above the guns in the view we reproduce in Fig. 1.

In applying such patches, ventilating louvres and other complicated constructions were cut away under water until a satisfactory jointing surface was obtained. Again, for many of the larger patches strongbacks and supporting girders had to be arranged for and placed in position. The water-tight joint between the hull and the deck was in nearly all instances made by a pad or "pudding" of oakum, covered with a layer of canvas. Before finally screwing down, the surface of the patch and the hull was thickly coated with tallow, but it was quickly found that this material was at once eaten away by shoals of small fish. The simple and ingenious expedient of mixing a little Portland cement with the tallow was resorted to, and it was found that the joints remained untouched, and set quite hard under water.

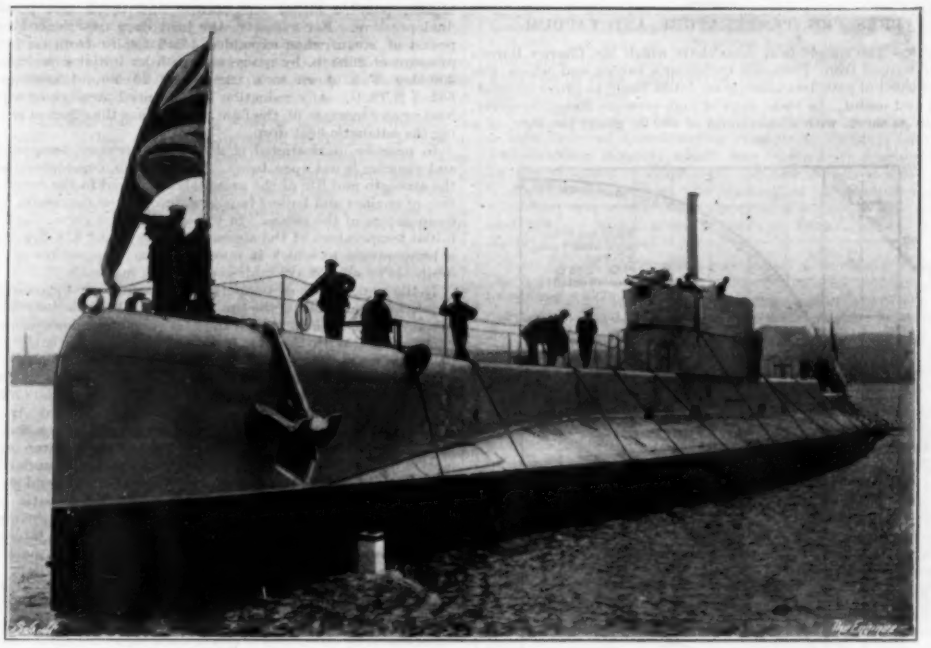
The Pumping Operations.

As soon as the patching of the ship was well advanced, the question of the sequence of pumping operations fell to be considered. The pumps employed may be conveniently divided into two classes. First, those which were self-contained and driven by oil engines, and, secondly, those which were worked by power supplied from generating plants fixed on the surrounding pontoons. Among the former class were several oil engine driven 12in. Conqueror pumping sets by W. H. Allen, Sons and Co., Ltd., of Bedford, and others by Drysdale and Co., Ltd., Yoker, Glasgow, and Lindsay, Swan and Hunter, Ltd., of Newcastle-upon-Tyne. The pumps of the second class consisted mainly of a series of twenty or more 6in. submersible pumps, which were built by Submersible Motors, Ltd., of Southall. These pumps proved particularly useful throughout the salvage operations on account of their flexibility. They were connected to the generating plant on the pontoons by cab-tired sheathed cables, and current was supplied by alternating-current generators driven by belting from steam engines, the steam being supplied by the two water-tube boilers which failed at the critical moment when the maximum pumping power was required.

As the top deck of No. 2 turret was just above high water even at spring tides, it was decided to make that turret the starting point of the operations. All machinery was removed from the centre of the turret, and as the water was lowered by pumping, all internal hindrances were cut away, so that a clear passage right to the bottom of the ship was given. By using this passage, it became possible to place the submersible pumps at the lowest possible level in the ship, right at the beginning of pumping operations. On the occasion of our visit, preliminary pumping trials were in progress, and for this purpose two 12in. pumps were placed on the turret deck, with their suction pipes in the turret sump, and six submersible pumps at the bottom of the ship. The total output corresponded to 3600 tons of water removed per hour. Before these trials, all the doors in the forward compartments of the ship were lashed back in an open position by divers, so that there was no possibility of bodies of water being imprisoned in compartments

H. M. SUBMARINE OBERON

CONSTRUCTED AT CHATHAM DOCKYARD



and so upsetting the trim of the vessel, and giving rise to undue hull stresses. In order to gauge the fall of water over the whole fore part of the ship, and to provide air for the empty compartments, a wooden trunk was built over a hatch at the forward end of the ship.

Arrangements were also made to protect the deck openings to prevent water being shipped when the vessel took an extreme list. About the middle of August definite attempts to raise the vessel were made, and she was lifted, as our illustrations, Figs. 1 and 3, show, both at the bow and the stern ends. It was found that the ship had settled down on a mass of rock, but fortunately the hull had not been pierced. When she was raised partially above water—as indicated in the views given—the interior was carefully examined, and it was found that practically the whole of the water-tight bulkheads were pierced—in some instances, owing to corrosion, and others, no doubt, by reason of the tremendous inrush of water when the vessel was originally scuttled. This being so, when the distribution of the pumps was not quite balanced, the ship took on a natural list to port, which tended to increase as the water from the various compartments drained to the port side. Efforts to counteract this list, which were partly successful, included the securing of tackle to the mast heads—see Fig. 5, page 362—and fastening hawsers to the pontoons or to sunken destroyers which were placed at suitable points.

Port lists from 20 deg. to 30 deg. were safely carried, and at the end of August when the final lifting operations were begun, after pumping out the forward compartments of the ship, the list increased to a maximum of 35 deg. Fig. 2 gives a view of the ship taken just before she attained the maximum list. For a period of about one hour at high tide during one evening the Hindenburg remained in this precarious position. It was unfortunately not possible to right her and to bring her completely to the surface, owing to the completely unexpected failure of the tubes of the water-tube boilers which were supplying steam to the generating sets producing current for the submersible pumps. The most important and flexible pumping units were by this failure completely deprived of current, and the pumps which remained were totally inadequate to meet the pumping requirements which the righting operations demanded. At this critical time, a storm was also at its height, and seriously interfered with the carrying out of the operations. When the boilers failed, the firm decided to seek to obtain steam to drive the engines of the generating sets from one of its large tugs which was moored alongside the lifting pontoon, but owing to the poor quality of the foreign coal and the fact that the ship was stationary, enough steam could not be raised.

After carefully considering all factors, it was reluctantly decided to sink the ship once again and to defer the final lifting operations until the spring of next year.

Further Work.

The operations to which we have referred and which have taken place during the last two months, have all been carried out under the personal supervision of Mr. E. F. Cox, the managing director of the firm. On his recent return from Scapa Flow, Mr. Cox was good enough to give us some further information regarding the plans for the salvage work of the coming winter season. The four pontoons which were grouped around the Hindenburg have now been towed to Mill Bay, where they will be overhauled, the machinery put in order, and the lifting gear rearranged, so that when completed the two large pontoons will, when placed alongside the Hindenburg, have a steadying effect equal to a lift of about 24,000 tons.

Meanwhile, work has been begun on the upturned and nearly totally submerged battle-cruiser Moltke. It is proposed to lift her by closing the apertures in the hull and introducing compressed air, thereby driving out the imprisoned water. When this is done, the ship will be transferred to shallower water, where she can be dismantled, thus providing work for the firm's shipbreaking department at Lyness Pier.

Reviewing the work of the past four and a-half months, it seems to us that no mean task has been undertaken, and that even though deserved success was not at first attained, owing to the defects in boiler tubes referred to, the effort has not been without its compensations. When work is begun early next spring, it will mean that the final task of bringing the ship to the surface will be considerably shortened by the application of the knowledge and experience gained during the work of the recent short season of salvage operations. In a work of this magnitude, the loyal co-operation of both staff and men is most essential, and on the occasion of our recent visit, we were struck by the excellence of the team work, which, we believe, has played, and will again play no small part in the success of these salvage operations.

Launch of H.M.S. Oberon.

The submarine Oberon, which was launched at Chatham Dockyard on Friday last, is the first of a new class of submarines which appear to have been designed for oversea service. A characteristic of the type is its seaworthiness and extensive radius of action. In both respects it represents a marked advance on the smaller "L" boats, which form the bulk of our present submarine flotilla. Few particulars of the Oberon have been divulged, but the official "Return of Fleets" gives the displacement as 1345 tons on the surface and 1750 tons submerged. The new vessel is thus considerably smaller than the X 1, of 2525 tons surface displacement, and is also exceeded in weight by the K 26, of 2140 tons, and the two "M" boats, of 1600 tons. On the other hand, the Oberon is heavier by 385 tons than the largest vessels of the "L" class. The preliminary trials of the new boat are already proceeding, as it appears to have been launched in a forward state. The commanding officer is Commander G. D'Oyly Hughes, D.S.O., D.S.C. Two submarines of similar design, built to the order of the Australian Government, have been launched this year from the Vickers' yard at Barrow, the Oxley on June 29th and the Otway on September 7th. Provision is made in the current Navy Estimates for laying down six "O" type submarines, but no contracts have been awarded so far. From 1927–28 to 1929–30 inclusive six further boats are to be begun each year, seventeen of these being of the "O" type and one a fleet submarine. Including the Oberon and the Australian units, twenty-seven new submarines will thus be added to the Imperial naval forces in the course of the next few years.

It is announced that Mr. C. A. Moore, of the Belfast and County Down Railway, the *doyen* of Irish railway general managers, retired at the end of September. Mr. W. F. Minnis, the traffic superintendent, becomes acting general manager.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

PRESSURE, TEMPERATURE AND VACUUM.

Sir,—The simple heat drop chart which Mr. Charles Barnes has derived from Professor Callendar's tables, and which you published in your last issue, is no doubt likely to prove interesting and useful. In these days of high-pressure steam, however, it stops short, with a maximum of 400 lb. gauge pressure, of a

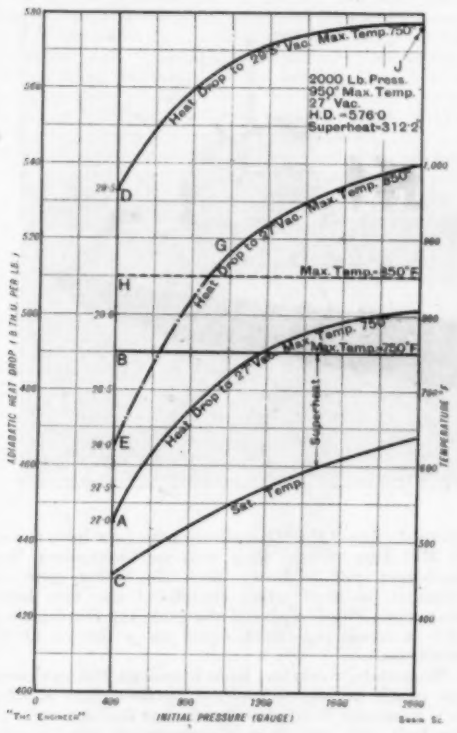


FIG. 1

region which is now engaging much attention. In addition, the effect of superheat has, as Mr. Barnes states, to be allowed for by calculation, and cannot be read off directly from the chart. Moreover, the chart fails to reveal the relative advantages of high pressure, high temperature and high vacuum. I submit the following notes on this important subject in the hope that they may help to make the position somewhat clearer than many engineers seem at present to find it.

To improve the efficiency of steam prime movers or—an object of at least equal importance nowadays—to reduce the weight and volume of machinery required for the development of a given power, three courses of a thermodynamic nature are open to us. The pressure at which the steam is supplied may be increased; the degree to which the steam is initially superheated may be raised; the back pressure against which the steam is exhausted may be lowered. All three courses may be resorted to simultaneously, for, theoretically, they are quite independent of each other.

To determine the extent to which each course should be employed in order to achieve the desired result in the best possible manner is a problem of no little complexity. From the purely theoretical point of view, the problem is to present the steam to the engine and to employ it therein under conditions which are such that the heat available for conversion into work in each pound of steam supplied is as great as possible. In other words, the heat drop experienced by the steam in expanding adiabatically from the initial pressure and temperature to the pressure and temperature of the exhaust should be of the maximum possible amount.

This requirement considered by itself implies that we should use the highest possible initial pressure combined with the highest possible initial temperature and the lowest possible final pressure. For example, the heat drop experienced by a pound of steam when expanded adiabatically from an initial pressure of 2000 lb. by gauge and with an initial superheat of 300 deg. Fah. down to a vacuum of 29·5in. of mercury is 652·5 B.Th.U. Any reduction of the initial pressure or superheat or any increase of the final pressure has the effect of reducing the adiabatic heat drop.

In practice, unrestricted choice of the pressure, temperature and vacuum is not open to us. For example, considerations of the strength and life of the materials employed in the construction of engines and boilers impose a limit on the maximum total temperature of the steam. In the example just given, the total initial temperature of the steam would be about 938 deg. Fah., a temperature to which it may be deemed impossible or undesirable to subject available constructive materials.

If the upper limit of temperature is prescribed by reason of practical requirements, the problem of choosing the best initial pressure and temperature and the best vacuum begins to acquire complexity. With the aid, however, of certain recently published tables a clear picture of the problem can be readily presented. The tables referred to are "The Enlarged Heat Drop Tables," calculated by Dr. Herbert Moss, of the Imperial College of Science and Technology, and published by Edward Arnold and Co., London, price 10s. 6d., on behalf of the Turbine Section of the British Electrical and Allied Industries Research Association. The data given in Dr. Moss' tables have been derived from Professor H. L. Callendar's well-known formulæ and steam tables, and represent an extension of certain adiabatic heat drop tables published in 1917. The new tables extend the maximum initial pressure from the 400 lb. of the earlier tables to 2000 lb., and carry the vacuum down to 29·5in. of mercury. The range of initial superheat is from zero to 300 deg. Fah.

By simple interpolation, the data given in Dr. Moss' new tables have been used for the purpose of plotting the curves given in the accompanying diagram—Fig. 1. Curve A shows the heat drop experienced by one pound of steam when expanded adiabatically from any pressure between 400 lb. and 2000 lb. by gauge down to a vacuum of 27in. of mercury, the initial temperature in all cases being fixed at 750 deg. Fah. The difference between curves B and C represents in each instance the initial degree of superheat in the steam. The effect of employing a higher vacuum is shown by the curve D, which represents the heat drop when the vacuum is 29.5in., the maximum initial temperature being, as before, 750 deg. Fah. In order to avoid complicating the diagram, the heat drop curves for vacua between 27in. and 29·5in. have been omitted, but the points at which the curves would intersect the ordinate through 400 lb. initial pressure are indicated. Curve E shows the heat drop when the vacuum is 27in. and the maximum temperature is raised to 850 deg. Fah. Beyond the point G on this curve the initial superheat, as represented by the difference between curves H and C, exceeds the limit of 300 deg., to which Dr. Moss' tables extend. The probable trend of the curve at pressures below that corresponding to the point G is indicated. If the maximum permissible temperature is raised another 100 deg. to 950 deg. Fah., the initial superheat everywhere exceeds the limit of 300 deg. It is not desirable therefore to use the tables to show the heat drop at this level of initial temperature. At 2000 lb. pressure, however, the initial superheat, 312·2 deg., is sufficiently close to the limit to justify extrapolation. The point so obtained for 2000 lb. initial pressure, an initial temperature of 950 deg. Fah. and a vacuum of 27in. is indicated at J.

A study of the curves given in the diagram provides some interesting deductions. Perhaps the most striking one is the relative smallness of the gain to be achieved by resort to the most extreme measures of augmenting the available heat drop. For instance, contrasting the lowest point of curve A with the highest point of curve D, it will be seen that the gain of heat drop achieved by increasing the vacuum from 27in. to 29·5in. and the initial pressure from 400 lb. to 2000 lb.—the initial temperature being kept constant at 750 deg. Fah.—amounts to 132 B.Th.U. per pound, or 29·6 per cent., reckoned on the lower figure. That figure may seem considerable, but the cost of realising it would probably be found prohibitive.

Considering pressure alone and contrasting the lowest and highest points of curve A, we notice that the gain of heat drop realised with a vacuum of 27in., and an initial temperature of 750 deg. Fah., by raising the initial pressure from 400 lb. to 2000 lb., is 56·6 B.Th.U., or only 12·7 per cent. If the vacuum is 29·5in., and the maximum temperature unaltered at 750 deg. Fah., curve D shows that a similar increase of pressure from 400 lb. to 2000 lb. will result in a gain of 44 B.Th.U. in the heat drop or an increase of only 8·2 per cent. The higher the vacuum, therefore, the less absolutely and by percentage is the gain realised by increasing the initial pressure, if the maximum initial temperature is not altered.

The curves also emphasise the rate at which the gain of heat drop falls off as the pressures are raised. For example, in both curves A and D more gain is registered by raising the pressure from 400 lb. to 800 lb. than by raising it from 800 lb. to 2000 lb.

Considering vacuum alone and contrasting the lowest points of curves A and D, we observe that with an initial pressure of 400 lb. and a maximum temperature of 750 deg. Fah., the gain in heat drop achieved by increasing the vacuum from 27in. to 29·5in. is 88 B.Th.U., or 19·8 per cent., reckoned on the lower figure. At 2000 lb. initial pressure, the gain achieved by a similar improvement of the vacuum is less, namely, 75·4 B.Th.U., or 15 per cent. The higher the initial pressure, therefore, the less absolutely and by percentage is the gain realised by improving the vacuum. It is interesting to note, however, that unlike increase of initial pressure, increase of vacuum is most effective in the higher ranges. For example, at 400 lb. initial pressure half the gain registered by increasing the vacuum from 27in. to 29·5in. is registered in the last ¼in. advance.

Projecting the highest point of curve A on to the ordinate A D, we notice that at 750 deg. Fah. maximum temperature no much additional heat drop is to be obtained by increasing the vacuum with 400 lb. steam from 27in. to 29in. as is obtained by keeping the vacuum at 27in. and raising the initial pressure from 400 lb. to 2000 lb.

Let us consider, finally, the effect of raising the initial maximum temperature. Contrasting curves A and E, it will be observed that with 800 lb. steam and a vacuum of 27in. the effect of raising the maximum temperature from 750 deg. to 850 deg. Fah. is to increase the heat drop by 30·7 B.Th.U., or 6·5 per cent. on the lower figure. With 400 lb. steam the gain, it is to be inferred, would be less. With 2000 lb. steam it would be greater, amounting to 37·9 B.Th.U., or 7·5 per cent. The point J shows that the gain achieved by increasing the initial temperature a farther 100 deg. to 950 deg. Fah. would be almost exactly twice as much, namely, 74·7 B.Th.U., or 14·9 per cent. on the 750 deg. Fah. figure. It would appear, therefore, that, at least at 2000 lb. initial pressure, the gain of heat drop is directly proportional to the increase in the initial temperature. Unfortunately, the limitations of the table do not enable us to discover whether this relationship holds for lower initial pressures.

Projecting the highest point of the curve A horizontally until the curve E is cut, it is to be inferred that with a vacuum of 27in. as much is to be gained from 750 lb. steam by increasing the maximum temperature from 750 deg. to 850 deg. Fah., as by keeping the maximum temperature at 750 deg. Fah., and raising the pressure to 2000 lb. Similarly, projecting the highest point of curve E horizontally until curve D is cut, it will be seen that with 500 lb. steam at 750 deg. Fah. maximum temperature, more is to be gained by increasing the vacuum from 27in. to 29·5in. than by keeping the vacuum at 27in., and raising the initial pressure to 2000 lb. and the initial temperature to 850 deg. Fah. The position of the point J also indicates the great importance of a better vacuum, as compared with higher superheat, for it shows that with 2000 lb. steam an improvement of 2¼in. in the vacuum produces the same gain in the heat drop as a rise of the initial temperature from 750 deg. to 950 deg. Fah. It is again to be regretted that the limitations of the tables do not permit us to examine this point more closely.

In Fig. 2 the various results deduced from the curves are set out in the form of a graded diagram.

T. W. Bromley.

London, September 27th.

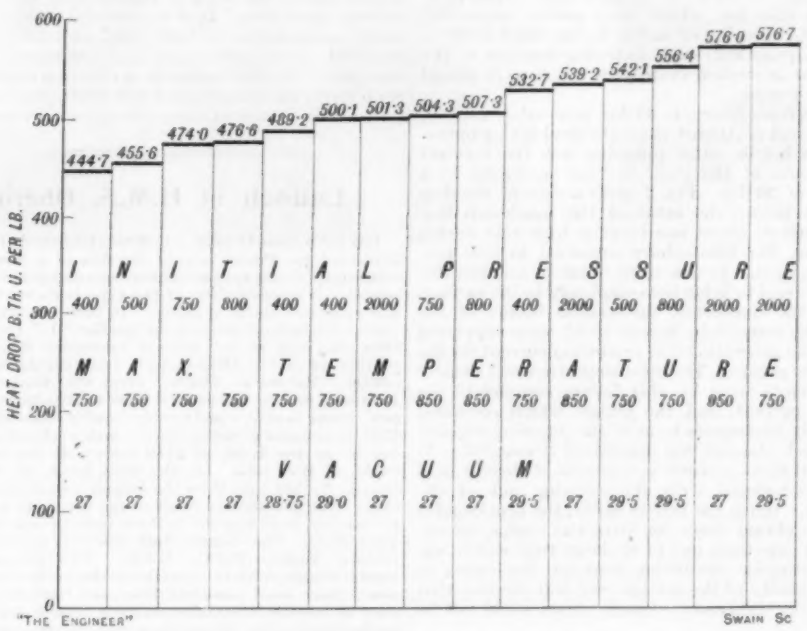


FIG. 2

GRAIN DUST AS FUEL

Putting to use their knowledge gained in the study and prevention of dust explosions in grain elevators, Mr. W. A. Noel, associate engineer of the Dust Explosions Division of the Bureau of Chemistry of the United States Department of Agriculture, and Mr. Rudolph Hellbach, technician of the Colour Laboratory of the same Department, succeeded recently in running a Ford automobile motor with grain dust. It is proposed to use this waste fuel for stationary engines when the experimental engine advances to a more practical stage, and the means for proper feeding of the dust is devised. It is estimated that 6 lb. of grain dust are equal to 1 gallon of petrol in calorific value.

The experiments have been carried on at the Arlington, Va., experiment farm of the United States Department of Agriculture. An ordinary Ford automobile engine was used. The carburetter was removed and to the intake manifold was attached a metal tube which connected the engine with a chamber equipped with a small fan and circulating pipes to produce an updraught of air to keep the dust in suspension.

It was found that to operate successfully a well-balanced proportion of dust and air must be maintained, and that the compression stroke collected dust on the top of the piston before ignition occurred. Later, a piece of 6in. pipe was forced into shape to fit round a cylinder, with valves in the top and back. A plate glass was clamped over the top of one cylinder for observation and the other covered with a steel plate. The ignition system was replaced with a regular Ford distributor and a lamp bank using 110 volts from the laboratory power line. The manifolds were removed and the dust fed by hand through a tube to the intake valve. After twelve successive explosions had been observed, the glass plate was shattered by an explosion, and bits were thrown 30ft. into the air.

The Ministry of Transport inquiry, conducted by Lieut.-Colonel Mount, into the Naworth level crossing disaster of August 30th was completed last week. No fresh light was thrown on the cause of the accident, but evidence was given by the respective drivers of two motor vehicles that on June 28th they both found the gates open for the roadway and, as one was crossing and the other about to cross, a train passed.

Railway Matters.

A COLLISION occurred outside Carlisle Station in the early hours of the morning of September 22nd. According to the official statement of the London, Midland and Scottish Company, the 9.30 p.m. express from Euston overran the signals and collided with a light engine.

THE electrical services on the South London line of the Southern Railway, *i.e.*, between London Bridge and Victoria, which were not reopened after the general strike, have now been restored. East Brixton, Clapham-road, and Wandsworth-road stations have, as a consequence, been reopened.

CONSIDERABLE damage was done at the Exchange Station, Bradford, one evening recently. The shunter in charge of eleven empty coaches signalled the driver of the engine to set back. Contrary to the expectations of the shunter, the five vehicles furthest from the engine had not been coupled to the others, so, the line being on a steeply falling gradient they ran away and collided at high speed with the buffer stops.

WE regret to learn that Colonel C. W. P. Ramsey was recently killed in a motor car accident near Montreal. When holding the office of chief engineer of construction on the Canadian Pacific Railway he went, in March, 1915, to France and eventually was appointed railway construction engineer to the Fifth Area. Towards the end of the war the strain became too much for him, and he was given lighter work and subsequently returned to Canada. After a few months in railway service he left it to set up in private practice.

THE demonstration at Belle Vue, Manchester, organised by the National Union of Railwaymen a year ago in commemoration of the railway centenary, was so successful that it was repeated on Sunday last. As on the former occasion, the chief officers of the London, Midland and Scottish Railway took part in the proceedings. Sir Josiah Stamp, the president of that company, was one of the party, and incidentally remarked, in relation to the visits paid separately by himself and Mr. J. H. Thomas to America, that whilst neither of them would belittle the wonderful things America could do in railway work, they were confident that Britain was holding its own in railway services.

THE further particulars that are available since our last issue as to the collision on September 23rd at Vulaines-sur-Seine show that a coupling broke on the first train and some of its carriages were left standing on the main line. The block system was evidently out of order and the driver of the second train was advised of that fact at the signal-box in the rear. He maintains, however, that, on approaching Vulaines, the signals were in his favour and thus he was unable when, out of the fog from the river, he saw the standing coaches, to pull up in time. The driver's statement that the signal was at "clear" receives some corroboration from the fact that the line at that point is equipped with cab signals and the locomotives with speed recorders. Had the signal been "on" the cab signal would have caused the whistle to be blown and the fact indicated on the speed recorder. Of the latter there was no trace.

IN our occasional references to State-owned railways we have sometimes used the argument that British railways have throughout been built by private enterprise. We have, however, always made a point of exempting some of the railways in Ireland and the West Highland Railway. The latter, under an Act passed on August 14th, 1896, enjoys a Treasury guarantee of 3 per cent. interest on £260,000 towards its extension from Banavie to Mallaig—authorised in 1894 and opened on April 1st, 1901, and a grant of £30,000 towards the pier at the latter place. One condition of those financial arrangements is a certificate yearly from the Board of Trade—now the Ministry of Transport—inspecting officer that the line is efficiently maintained. One of the main works on the line is the Glenfinnan Viaduct, 1248ft. long, of twenty-one spans, at a maximum height of 100ft. It is built of concrete. Mention is now made of these facts because Colonel Sir John Pringle recently made his inspection, accompanied by the chief officers of the London and North-Eastern Railway.

LAST Wednesday week, September 22nd, was the eightieth anniversary of the opening of the first half of one of the most important sections of the British railway system. We refer to the Lancaster and Carlisle, which was opened from Lancaster to Oxenholme on September 22nd, 1846, and carried through to Carlisle on December 15th, 1846. Owing to the hilly nature of the country in the neighbourhood of Shap, the best route from Lancaster to the Scottish border was considered by many, including George Stephenson, to be along Morecambe Bay and through West Cumberland and there to join the proposed Maryport and Carlisle Railway. That fine engineer, Joseph Locke, showed, however, that a line through Oxenholme and over Shap Fell was possible, and his scheme was sanctioned in 1844. Powers were obtained for a double line, but only a single track was at first to be laid. The authorisation of the Caledonian Railway in 1845, with the Lancaster and Carlisle thus becoming part of the then only through route to Scotland, led to a double line being laid.

IT has leaked out that Mr. J. H. Thomas has been nominated by the National Union of Railwaymen to act as its representative on a committee, under the Ministry of Transport, which is to inquire into the transport of coal by railways. That appointment suggests that the Government has in hand recommendation (3) of the Coal Commission given on page 105 of its report. The functions of the proposed committee were to be :—(*a*) To review the equipment provided for 20-ton wagons at the ports and railway terminals and at the collieries, and to make representations, when necessary, for its extension ; (*b*) to promote the formation of pools ; (*c*) to promote the standardisation of wagons ; (*d*) to undertake special inquiries : (1) as to the proper rebates in rates which should be allowed when 20-ton wagons were used ; (2) into such matters as the alleged greater loss from breakage through the use of larger wagons and the method of avoidance of such loss, if any ; (3) into the reasons for the small number of journeys per month travelled by the wagons and the remedies ; (4) if thought desirable, into the question of the use of canals for coal transport.

Notes and Memoranda.

FOR the past three years an experimental Bergius process plant has been working at the Fuel Research Board's Station at Greenwich, and it is understood by the *Colliery Guardian* that such progress has been made that a large plant for dealing with ¼ ton of coal a day is now being erected at the station. The Board is said to be working in liaison and complete conjunction with the Bergius Company in Germany.

ONE small plant making steel is operating steadily in Brazil. It has one blast-furnace, producing 25 tons of pig iron per day, with a second under construction. One open-hearth furnace of 5 tons is running, while another is being built, the second to be one of 12 tons. A 14in. blooming mill and a 10in. finishing mill are run by rope drive from an electric motor. About 20 tons of rolled products are turned out per day.

AN order for a steam turbo-generator of 104,000 kilowatts has been placed with the Westinghouse Electric and Manufacturing Company by the Commonwealth Edison Company (America). The new set is to be installed at the Crawford Avenue Generating Station, bringing the total capacity of the latter up to about 450,000 kilowatts. The turbine will operate with steam at 550 lb. gauge pressure, a temperature of 720 deg. Fah. and a 29in. vacuum.

A COMMUNICATION received from the Mellon Institute of Industrial Research, Pittsburg, Pa., states that a new process for manufacturing triethylamine and diethylamine has been developed there by Dr. D. K. Tressler and his assistants. The cost of production of the amines is said to have been considerably reduced, and it is anticipated that they will find extensive industrial applications, many of these being suggested. No details of the method are disclosed.

SO remarkable have been the results attending experiments with crops in the vicinity of wireless aerials near Potsdam, that the Prussian Government has appointed a scientific commission to investigate the phenomenon. Two fields, one with a number of aerials and the other without them are being used for the tests. It is reported that the field with the aerials, notwithstanding poor soil, has produced rich crops of wheat, rye, potatoes, and other vegetables, whereas the other remains unproductive.

A MINE, situated on the Marsh Fork extension of Big Coal River, in Raleigh County, West Virginia, is, according to the *Iron and Coal Trades' Review*, equipped with a conveyor 2659ft. long. As originally installed there was but one transfer point—at the centre. The 1348ft. lower section proved to be too long, so a third transfer has been installed, 524ft. from the railway tipple. The difference in elevation between the head sheave and tipple is 1112ft., and the horizontal distance 2413ft.

THE development of a new steel product—steel with a high resistance to wear but a soft core—is announced by the Jones and Laughlin Steel Corporation. The company's officials say that the product, which is named "Jalcase," will reduce production costs and speed up the output of parts for machines where steel of great wear resistance is required for moving parts. "Jalcase," it is said, with its hard surface and soft core, possesses the triple combination of fast machining, case hardening and forging properties.

IN an article on "Characteristics of Single-phase Motors," appearing in the *Electric Journal* for September, Mr. T. O. Walz states that one and one-quarter million small single-phase motors will be manufactured this year in the United States. This may seem to be an extremely large number of motors, but it is probably a conservative estimate. A very large percentage of these motors will be used to operate household appliances such as washing machines, ironers, pumps, water systems, refrigerators, oil burners, utility motors, &c. Probably half a million of these motors will be used on washing machines. Two fairly new developments which use a large number of motors are domestic electric refrigerators and domestic oil burners.

TESTS conducted at the Pittsburgh, Pa., experiment station of the United States Bureau of Mines, have demonstrated that some oil shale dusts are explosive, and that their explosiveness increases with their combustible content. The formation of dust during the mining and handling of oil shale is almost unavoidable, and the Bureau considers that the same precautions against dust explosions should be taken in the industries producing or working with oil shale as are taken in safely-operated coal mines. The dust produced in Scottish shale-mining operations, according to some investigators, is non-inflammable and non-explosive, but the results of the tests made by the Bureau of Mines show that oil-shale dust may present a source of danger in American mines, particularly when comparatively rich material is being worked.

THE rail mill at the Steelton plant of the Bethlehem Steel Company, Steelton, Pa., U.S.A., has recently been electrified. The mill consists of a 35in. two-high roughing stand in which 9in. square blooms are given five passes, and two 28in. three-high stands in which five more passes are made, completing the rolling of the rail. The hitherto existing reversing engine driving the 35in. mill has been replaced by a 3500 horse-power 500-volt, direct-current reversing motor supplied with power from the general system through a motor generator set situated in the motor-room, and the engine driving the 28in. non-reversing mill has been replaced by a 4000 horse-power continuous rating 6600-volt, 25-cycle, 8-pole slip-ring induction motor with a synchronous speed of 375 revolutions per minute. On the same base with the motor is mounted a steel plate fly-wheel 14ft. 7in. diameter by 11in. thick, weighing approximately 75,000 lb., and this in turn is coupled to a gear-reduction set with a ratio of 24 to 102, thus giving the mill a speed of 85 to 90 revolutions per minute. This motor and the steel plate fly-wheel are both duplicates of the motor and fly-wheel driving the motor-generator set which supplies power to the reversing motor for the 35in. mill. The last rail rolled by the mill with the steam drive was on the afternoon of July 3rd, and the first rail rolled with the new motor equipment was on July 31st, just four weeks later.

Miscellanea.

INVESTIGATIONS by the Building Research Board of the Department of Scientific and Industrial Research show a disquieting increase in the importation of foreign building materials. The imports of tiles in 1923 were valued at £93,000, last year at £430,000 ; bricks imported in 1913 numbered 2,800,000, last year 159,000,000 ; cement £395,000 in 1923, £540,000 in 1925 ; slates in 1920 £1000, last year £85,000.

THE Theosophical Society in Australia has established a high-powered broadcasting station at Sydney, says the *Indian News Service*, which was opened on August 24th by the Minister of Education for New South Wales. Mr. G. S. Arundale said at the opening of the station that it would be one of the most powerful stations in the world, and that it would soon be able to broadcast to India, America and Africa.

THE Bootle Corporation has issued a brochure, "Bootle Commercially Considered," describing the potentialities of the borough for trade, and giving particulars of the new docks and quays which are to be constructed by the Mersey Docks and Harbour Board within the district. The new Gladstone graving dock will, it is stated, be larger than the Southampton floating dock. Copies of the brochure can be obtained on application to the Town Hall, Bootle.

WORK on the reconstruction of the Port of Buenos Aires, which has been completely suspended for some time owing to the lack of funds, is about to be resumed. To finish the most necessary part of the contract a further 15,000,000 pesos (gold) will be required, which will bring the total expenditure to 35,000,000 pesos. The deepening of the channel from 30ft. to 35ft. and the widening from 328ft. to 492ft. will cost 11,860,000 pesos. Damage, to the extent of 5,000,000 pesos, occasioned by fire in January, has also to be made good. Meanwhile much inconvenience is experienced by vessels at the port, owing to the inadequate facilities for dealing with the increased traffic.

The *Swedish Economic Review* for the third quarter of 1926—published by the Swedish Board of Trade—says that employment in the shipbuilding industry during the last few months has improved and the electro-mechanical trade has continued its activities under satisfactory conditions. On the other hand, the depression in the iron industry has continued. The returns for the first half of the current year show that electrical machines to the value of 12,556,000 kronor were exported, as compared with 8,381,000 kronor during January-June, 1925. The exports of telephone and telegraph apparatus were valued at 2,825,000 kronor, as compared with 3,065,000 kronor.

THE Public Health Committee of the Tiverton Town Council has had under consideration the question of providing a better water supply, and in a provisional report presented at the September meeting of the Council recommended that the supply from Allers, of which full use was not being made, should be pumped to the present waterworks, and that the latter should be enlarged by additional storage and filtration tanks. It was stated that this would involve the expenditure of a good many thousand pounds. The Committee was instructed to prepare a further report on the matter, and to present it at the October meeting of the Town Council for consideration.

ACCORDING to the *Electrical World*, negotiations are proceeding between the St. Gall-Appenzell Electric Power Company and the authorities of the Glarus for the construction of an unusual type of hydro-electric station to utilise the water power of Lake Mutten, the Limmern Falls, and the Upper Linth River in East Switzerland. The scheme provides for a continuous output of 115,000 horse-power. Lake Mutten will supply the water in the winter months, with the Limmern Falls intake as a supplementary feeder, while the river Linth will furnish the power in the summer. The generating station will be installed at Tierfeld, near Linthal, at an estimated cost of 10,292,000 dollars.

THE Chilean Government has granted a concession for the construction of a hydro-electric plant on the river Bio-Bio, near Concepción, the chief manufacturing and trading centre in Chile. A fall on the river, approximately 24 miles from Concepción and 35 miles from the port of Talcahuano, will be utilised, its waters being estimated to yield a maximum of 3000 to 4500 horse-power, with an average of between 900 and 1200 horse-power. Current for lighting and industrial purposes will be supplied to Concepción and district and to the port of Talcahuano. The cost of the undertaking is estimated at 4,000,000 pesos, including 1,200,000 pesos for machinery and plant. A decree of August 22nd established the gold parity of the paper peso at 6d.

THE waves will keep the treasure which sank with the Egypt for another year at least. The Iroise, which has been conducting the salvage work, left the spot on September 19th, and operations will not be resumed again till next spring. Nevertheless, during the last attempt, a diver created a record by descending to a depth of 125 m. He discovered the grappling iron, but, unfortunately, it had missed the Egypt, and had caught in a tangled mass of cables. When these were fished to the surface, they were found to be relics of previous attempts, with the astonishing addition of a submarine telegraph line, belonging probably to the Brest–Dakar service. Under the circumstances, the only thing to do was to cut the grappling iron and let its load sink to the ocean bed again.

As a result of the new electrical code recently introduced into Mexico by the Government, raising and standardising the class of equipment permitted to enter the country, a wider demand has been created for electrical equipment and apparatus. Owing to the political and religious unsettlement, trade is generally dull and collections on account are somewhat difficult, but a marked improvement in the electrical industry is noted. This trends towards sales of electrical apparatus of superior makes. The use of cheap grades of lamp wire and sockets is prohibited by the new regulations. Supplies of cheap German sockets are to be withdrawn from sale. All electrical installations must in future conform strictly to the new code, which is not expected to affect the large electric light and power companies.

THE SCAPA FLOW SALVAGE OPERATIONS

(For description see page 358)

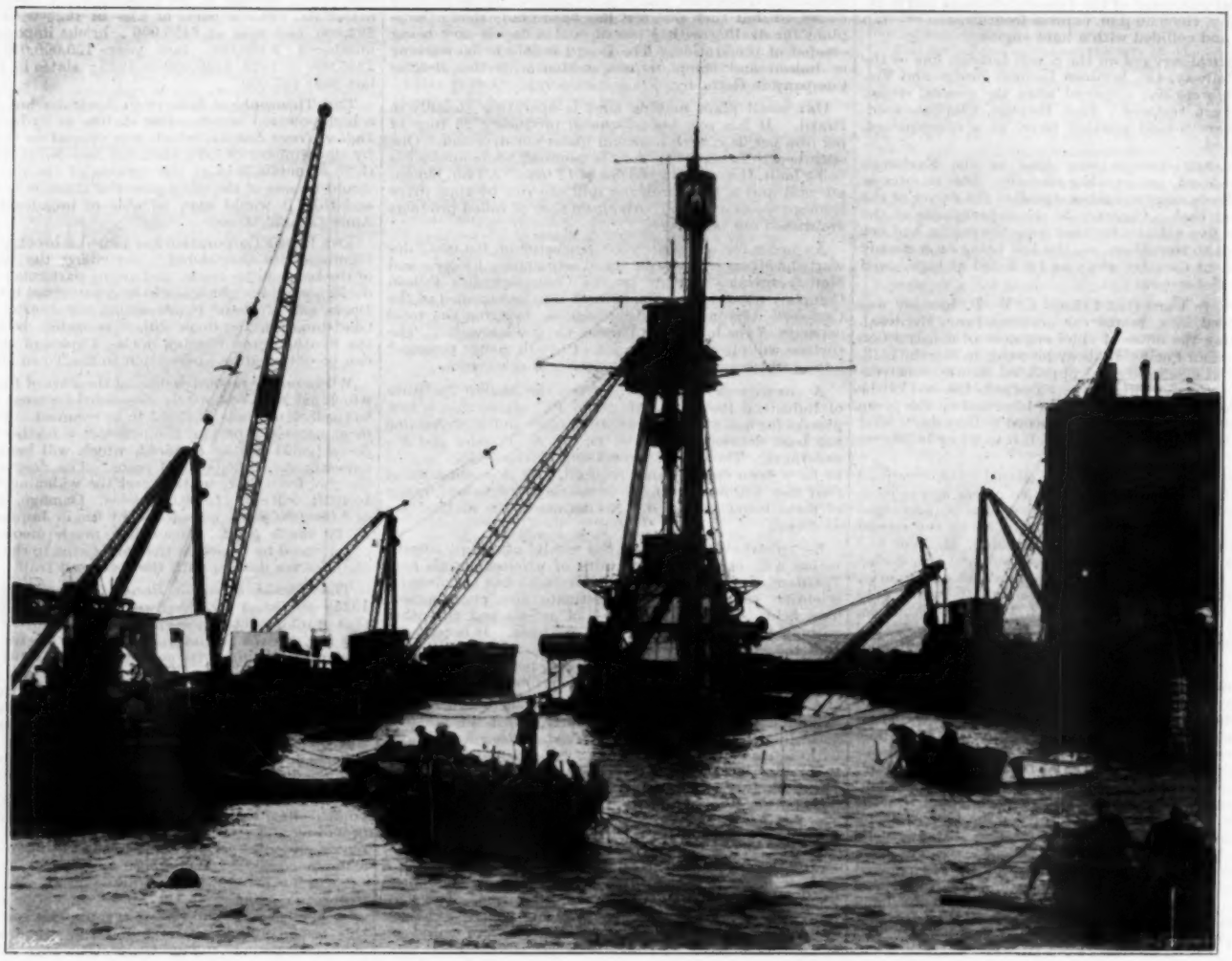


FIG. 4—GERMAN BATTLE-CRUISER HINDENBURG AND SALVAGE EQUIPMENT

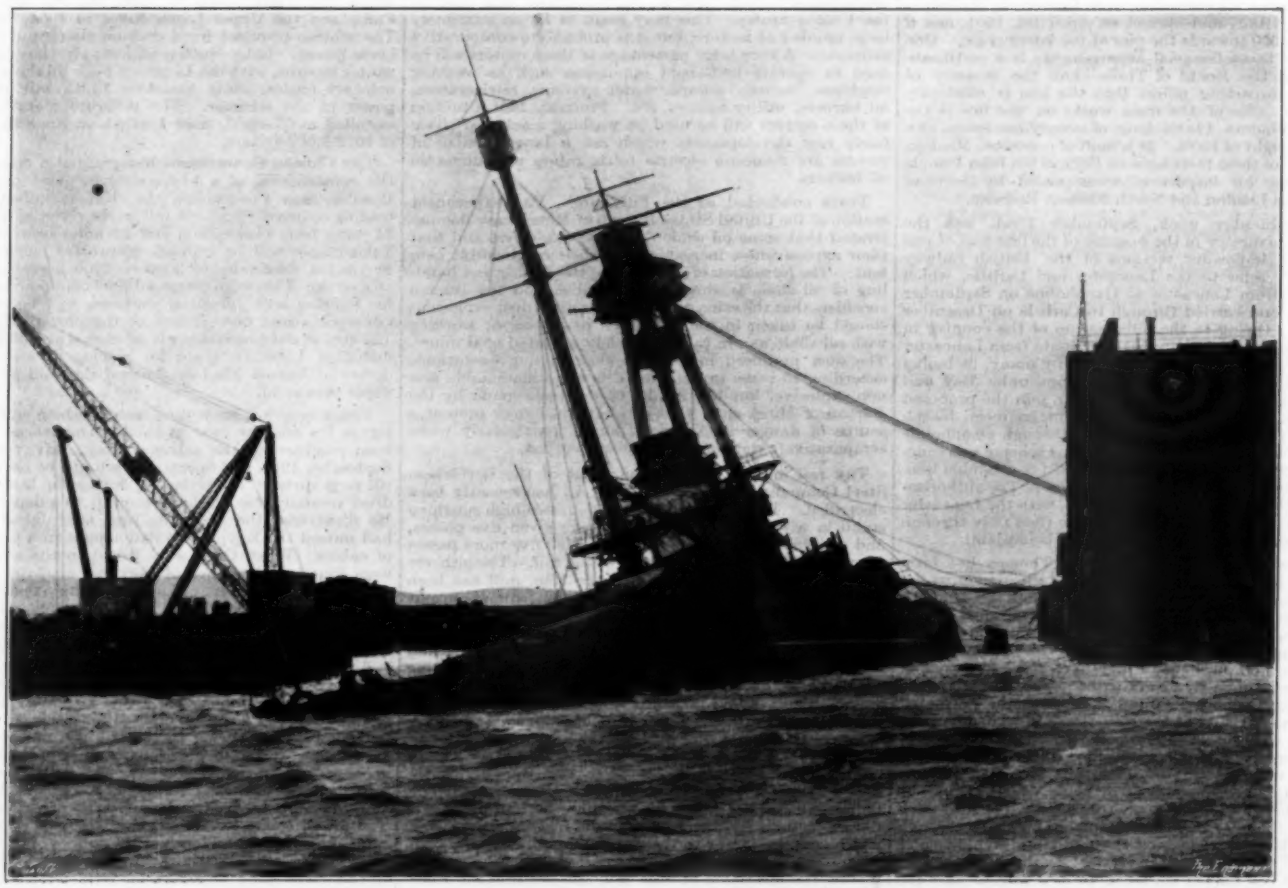


FIG. 5—THE HINDENBURG PARTLY RAISED SHOWING THE LIST TO PORT

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The Engineer

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FRANCE.—Boyveau and Chevillet, Rue de la Banque, Paris.
Chapelot and Cie., 136, Bld. St. Germain, Paris.

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NEW ZEALAND.—Gordon and Gotch, Limited, Wellington and Christchurch; Upton and Co., Auckland; J. Wilson Craig and Co., Napier.

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UNITED STATES OF AMERICA.—International News Co., 83 and 85, Duane-street, New York; Subscription News Co., Chicago.

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PUBLISHER'S NOTICES.

*** *With this week's number is issued as a Supplement a Two-page plate illustrating the Luabo Cane Sugar Factory of Sena Sugar Estates, Ltd. Every number, as issued by the Publisher, contains a copy of this Supplement, and Subscribers are requested to notify the fact should they not receive it.*

*** *If any Subscriber abroad should receive* The Engineer *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** *All letters intended for insertion in* The Engineer *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

The Engineer, October 1st, 1926.	Page
A Seven-day Journal	351
Luabo Cane Sugar Factory. No. I. (Illus.)	352
Continental Air Progress	354
Models and Analogies for Demonstrating Electrical Principles. No. VIII. (Illus.)	354
The Narrows Power Plant of the Virginian Railway Company. No. II. (Illus.)	356
The Scapa Flow Salvage Operations. (Illus.)	358
Launch of H.M.S. Oberon. (Illus.)	359
Letters to the Editor—	
Pressure, Temperature and Vacuum	360
Grain Dust as Fuel	360
Railway Matters	361
Notes and Memoranda	361
Miscellanea	361
Leading Articles—	
Government and the Coal Dispute	363
The Text Book and the Lecturer	364
Obituary—	
O. M. Row	364
Literature	364
The World Power Conference at Basle. No. IV.	365
Stresses in Cast Iron Pipes and Sockets. (Illus.)	366
Sixty Years Ago	368
The Artificial Drying of Crops. (Illus.)	368
Dalmarnock Power Station Extensions	368
H.M. Destroyer Ambuscade. (Illus.)	369
South African Engineering Notes	369
The Institution of Fuel Technology	369
Two New Scaling Tools. (Illus.)	370
Inland Navigation and Water Power in Spain	370
Welding Copper to Steel	370
Provincial Letters—	
The Midlands and Staffordshire	371
Lancashire	371
Sheffield	372
North of England	372
Scotland	373
Wales and Adjoining Counties	373
Personal and Business Announcements	373
Current Prices for Metals and Fuels	374
French Engineering Notes	375
British Patent Specifications. (Illus.)	375
Forthcoming Engagements	376
Contracts	376

Two-page Supplement—The Luabo Cane Sugar Factory of Sena Sugar Estates, Ltd.

THE ENGINEER.

OCTOBER 1, 1926.

Government and the Coal Dispute.

DAY by day the inevitable end of the coal stoppage approaches with increasing speed. The men are going back to the pits in larger numbers in each successive week. Already over one hundred and forty thousand have signed on, and, including safety men, something like two hundred thousand men are now at work. Before October is out, if matters are left alone, it is not improbable that the industry will have absorbed all that it is now capable of absorbing. Before the stoppage, approximately one million persons were engaged in and about the pits. An estimate from a trustworthy source has placed the capacity of the mines at the present time at no more than six hundred thousand. The closing of unprofitable pits and the months of idleness have reduced by forty per cent. the number of men that can now be usefully employed. As late as Monday last the miners' leaders and spokesmen continued to assert that the return to work was negligible. The fact is that already nearly one-third of the total complement, including the men who have never gone out, are at work. That cannot be regarded as an insignificant number, and in the last day or two even Mr. Cook has been obliged to admit that the "break-away" has reached significant figures. We rejoice over the rapid return of the men, but without a trace of vindictiveness. We have no desire whatever to see them beaten. They have, we firmly believe, been misled and have had to suffer in consequence. It is said that they are being driven back by starvation. That is an exaggeration. They may see want in front of them and are going back to avoid it, but there is no good evidence yet of actual starvation. But if they were starving they would only have their leaders to blame. The means of livelihood have been open to them; certainly since the passage of the Eight Hours Act, even if not before. To sentimentalise over their hunger is disingenuous. Bread there is for them and their families if they will work for it. Not as much as they would like, not as much as we would like them to have, but as much as, under the present conditions, an overstrained industry can offer them.

On many occasions we have had to regret the intervention of a Government in an industrial dispute; but never more than in this. Much as we sympathise with the Prime Minister in the difficulties which confronted him at the time, we cannot, in the face of all that has happened in consequence, do less than regret that the coal subsidy was ever instituted. There were always those who were determined, in pursuit of their own objects, to make the business a parliamentary affair, but had it not been for the subsidy and its *sequelæ* they would scarcely have succeeded in reducing it to the conditions to which it has now descended. It is a deplorable characteristic of the party system that sooner or later every question becomes a shuttlecock in the political game. The essentials are lost in the efforts of one side of the House to bring discredit upon the other. In essence, the coal dispute is an economic problem. It has nothing whatever to do with politics, and it is grievous indeed to see the time and ability of the House of Commons wasted, as it was on Monday afternoon, in word-chopping about the fractional meanings of sentences, the dates of letters, the nature of invitations and so forth. Mr. MacDonald's whole object upon that occasion seemed to be far more to discredit the Government than to solve the problem, whilst Mr. Lloyd George appeared more desirous of impressing the Labour Party than of helping the country out of its difficulties. Let anyone read the debate—not in the particular organ of the Press which they fancy, but in Hansard—and they, if they are not politicians, will be convinced that Parliament is incapable of dealing with disputes between employers and employed. The Prime Minister, who has managed to retain much of the common sense of the industrialist and to avoid complete political contamination, is clear upon that point. Speaking of the "times when Parliament has interfered, one way or another, with the conduct of industry," he said: "Whatever the effect of such interference may be or may have been, I am quite clear from what I have seen in the course of the last twelve months that it has done unqualified harm in this respect; and that is as to the feeling that it has generated that, however great the difficulties in the industry, however great the differences between the two sides, it is always possible for Parliament to get those two sides out of their difficulties and to settle their troubles for them." Fortunately, the course of events are taking the matter out of the hands of Parliament. With the passing of the Eight Hours Act—a permissive measure which, it appears, is being used with discretion—the possibility of a formal agreement automatically disappeared. The hours question was settled by that Act. The district question must settle and is settling itself. A national agreement on wages is impossible. Poor mines cannot pay as well as rich mines, and to ask the rich mines to bear some of the burden of the poor is bad economics—it could only result in an increase in the price of coal. A national agreement of a sort is indeed conceivable, but it could not do more than standardise a minimum which even the worst mine could pay. What advantage would ensue it is difficult to see. It is far better that the mines—owners and men—should have complete freedom than that they should be shackled by national agreements which are more likely to hamper than to promote that amelioration of the lives of miners and that reduction in the price of coal which the country so much desires.

We write in the interests of the economic renaissance of the country, and not with any bias towards the mineowners. It is probable that relatively few people outside the mining industry or mining areas have any conception of the number of employers. They are conversant only with the names of the bigger companies. It will, therefore, surprise them to hear that there are certainly not less than 2500 coal mines in the Kingdom and certainly not less than 1200 employers. Frankly, we believe many of them to be very bad owners, very bad employers. But there are many good owners and it is far more likely that the results which every humane man and every sound economist desires will be brought about by the pressure and example of the good mines than by any agreement which the mind of man can conceive. The Royal Commission indicated several important defects that have grown up with the extension and ramifications of the mining industry. Those defects are admitted. Some of them will right themselves if the industry is given freedom to develop; others might quite justifiably be corrected by Acts of Parliament—for in certain industrial affairs Parliament may play a beneficent part—whilst others may be corrected by the miners themselves or by public opinion. The mining industry can and will take an example from other industries if it is left free to work out its own salvation. The best mines will adopt progressive methods and pay the high wages which are associated with them, whilst the now unprofitable mines must be made profitable by improvements or disappear. But this end cannot be reached whilst the deliberate intention of some leaders is to make the mine unprofitable and unworkable, and when the industry can be dragged at the instigation of

a few into the political arena. Given freedom and peace, we see no reason to doubt that the influences which are constantly at work in other industries will be effective in our coal mines and will provide the men and the owners with what they desire and the country with what it so grievously needs.

The Text-book and the Lecturer.

The discussion on a paper which was presented at the recent meeting in Oxford of the Association of Special Libraries and Information Bureaux raised an interesting and important subject in connection with technical education. It was declared by one speaker that lecturers were in the habit of reading long extracts from text-books, another asserted that at University College, London, such a thing was unheard of, a third of the same College said that the practice did obtain, and Sir Richard Gregory, in concluding the debate, affirmed from his personal knowledge that the text-book method of lecturing still prevailed in many universities in this country. When reports of this discussion are circulated, assertions and counter-assertions will be rife in educational circles. We imagine that those who hold that "reading" from text-books is far from being a common practice will be able to prove their case with ease. Yet if we take the spirit rather than the letter of the statement, it is substantially true. Nearly all lecturers who give regular annual courses to successive students use year after year the same synopses, the substance of which may be found in their own text-books—not infrequently prescribed for use—or the text-books of others. It is difficult indeed to see how that plan can be avoided. To suit the requirements of examiners, certain subjects have to be dealt with, and it may justly be held that when a lecturer has discovered what he believes to be the best course of lectures to cover those subjects he should adhere to it. Few of the students hear the same lecture twice, and it is therefore essentially new to each group.

But a far larger issue lies behind the present matter. Is lecturing a good and necessary method of imparting knowledge to students following a specified curriculum? Mr. H. E. Potts, chairman of the Convocation of the University of Liverpool, whose paper it was that initiated the debate, seemed to have some doubts about their value, He urged that university students should be taught to use a library intelligently, and we may suppose that he thought they would be better employed in hunting up the answers to problems themselves than making hurried notes in the lecture room. It is, we fear, a fact that very few students do know how to make full use of a library, but that, we suggest, is rather the fault of the text-book and the examination than of lectures and lecturers. They require their information to be peptonised for them. By no other means can they hope to absorb enough of the matter, absurdly great in amount, on which they have to be examined. Still the fact remains that there are lectures and lectures, and lecturers and lecturers. In thoroughly capable hands, the lecture is an admirable way of imparting knowledge. The personality of the lecturer, the intuitive feeling—which he shares with actors—that he is holding his audience, his opportunity to use topical illustrations, even a little mannerism, give him advantages which are denied to the text-book. When, moreover, the lecture can be illuminated by experiments, such as Tyndall, Faraday or Silvanus Thomson performed with consummate skill, then indeed it stands unexcelled, even unequalled. But how often is this favourable conjunction of qualities and conditions to be found in the lecturers in engineering schools? Seldom indeed. Often, far too often, the lecturer has no special aptitude for the work. He has no personal hold over his audience, he fails to get into real touch and harmony with his hearers, and he is rather concerned to deliver himself of certain statements which they may jot down in their note-books than to feel and remove their difficulties. Lecturing is an art, not far removed from that of the actor. It requires a personality, a good voice, and that almost telepathic instinct which tells the performer whether he is "getting over the footlights" or not. Seeing how rare this art is amongst the teachers in technical universities, and how little likely it is to increase whilst the present method of selecting teachers prevails, it may well be asked if the lecture has not become an anachronism. It was invented at a time when books were scarce and when the verbal transmission of knowledge was necessary. But in these days, when books are too numerous rather than too scarce, there is little reason for continuing it as a part of regular courses; the students could employ their time better, as Mr. Potts suggested, in a good library.

That lectures enjoy many notable advantages over reading we shall not deny for a moment. But those advantages are only apparent in certain circumstances, and disappear entirely when the principal object in view is to stuff students with facts which they may disgorge in the examination hall. The lecturer should aim rather at encouraging broadness of view and stimulating adolescent imagination than serving out the same pabulum that is the common food of the class-room. Very few men have the necessary qualities, and that fact ought to be recognised by educational authorities. To imagine that because a man happens to be a great scientist, a great researcher or a great inventor, he will be even an adequate lecturer is to make a vast mistake. Lesser men will often enough do far better. The art comes, like acting, as a gift to some, but even in them it requires to be developed, and if lecturing is to become an effective part of our educational system it will be found necessary to train selected men especially for the work, and leave those who are clearly unfitted for it to the work of the class-room and the laboratory.

Obituary.

OLIVER MATTHEWS ROW.

The death occurred suddenly on Thursday last, 23rd ult., of Mr. O. M. Row, chairman of directors of Royles, Ltd., engineers, Irlam, near Manchester, and inventor of the well-known indented tube for feed-water heaters, &c. Mr. Row's health had been the cause of some anxiety to his friends for several years, but he continued to take a very active part in the successful business which he had done much to create until a few days before his death, which took place, owing to heart failure, whilst he was out driving at Rhos-on-Sea.

Mr. Row was born near Falmouth, Cornwall, in 1860, and served his apprenticeship with a firm of marine and mining engineers at Perran, Cornwall. He then went to Liverpool, and after working for several firms in that city became the owner of a business in Hanover-street, which made condensers and other appliances for marine purposes and for heating. It was while thus engaged that he invented the Row tube, in which the late Mr. John J. Royle, founder of the firm of Royles, Ltd., took an early interest. This interest developed until it resulted in Mr. Row giving up his own business in Liverpool and joining Mr. Royle's staff as consulting engineer. The Row tube proved such an instant success that in 1900 developments had to be made to cope with the increased trade. The firm was made into a limited company, with the title Royles, Ltd., and land to the extent of 5 acres was purchased at Irlam, on which the present large works was erected, the three joint managing directors being Mr. John J. Royle, Mr. O. M. Row, M.I. Mech. E., and Mr. H. C. D. Scott. On the death of Mr. Royle in 1919, his two sons, Messrs. G. E. and A. G., joined the board of directors, and Mr. Row was elected chairman, a post which he filled until his sudden end. Although somewhat outspoken and blunt of speech, Mr. Row was of a very kindly, sympathetic and cheerful disposition, and took an active part in all local social movements which had for their object the amelioration of the conditions of the workers. In addition to being a member of the Institution of Mechanical Engineers, Mr. Row was a Past-president of the Institution of Heating and Ventilating Engineers, and a member of the American Society of Heating and Ventilating Engineers. He leaves a widow and one son.

Literature.

SHORT NOTICES.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By J. W. Mellor. Vol. VI. Longmans, Green and Co., Paternoster-row, E.C. 4.—In Volume VI. of Dr. Mellor's excellent treatise, the section on the inorganic compounds of carbon, continued from Vol. V., is completed in the first 134 pages. The remaining 857 pages of text are devoted to silicon and its compounds. While the comprehensive treatise is essentially a reference book, and as such has no rival in the English language, it has not the dull character of most scientific reference books, which are little more than mere catalogues of facts. The author has struck a happy medium. He has made no attempt at grand literary style, and has wasted no words; yet the book is readable, and is more valuable on that account. A large part of the volume under review is taken up with an exhaustive description of the silicates and allied compounds, many of which are important members of the mineral kingdom. The very full treatment given is to be ascribed to the fact that Dr. Mellor is an authority on this branch of the subject. Indeed, it is doubtful if any other author of to-day would have attempted to include in a general treatise such a complete account of the chemistry of the mineral compounds of silicon. As in the companion volumes the references to scientific literature are exceedingly numerous, and should be adequate to satisfy the most exacting wants. The book is well printed, is singularly free from errors, and is provided with a serviceable subject index.

Journal of the Institute of Metals. Volume XXXV., 1926. Edited by G. Shaw Scott, M.Sc. London: The Institute of Metals, 36, Victoria-street, Westminster, S.W. 1. Price 31s. 6d. net.—The new half-yearly issue of the *Journal* of the Institute of Metals is divided into two sections, the first of which deals with the seventeen communications which were originally read and discussed at the spring meeting of the Institute. The subjects treated include the softening of strain-hardened metals; the brittle ranges of brass; the soft-soldering of copper; the corrosion of ancient tin; the properties of nickel and copper; the alloys of silver and tin; zinc oxide in brass; aluminium copper-tin alloys and other kindred subjects. Professor Carpenter's May lecture on "The Production of Single Crystals of Metals and Some of their Properties," is also reprinted. The second section of the volume is devoted to a mass of abstracts of metallurgical papers published throughout the world. The scope of this "Abstracts Section" is indicated by the fact that the list of periodicals abstracted itself covers eleven closely printed pages. The abstracts—of which there are thousands—appear above the initials of authorities in the various fields explored. All are so fully indexed and cross-indexed—as indeed are the contents of the original papers in the earlier section of the volume—that the names and subjects indices which complete the work cover upwards of 100 pages.

The Location of Mineral Fields. By M. H. Haddock. London: Crosby Lockwood. 1926. 9s. 6d. net.—To the uninitiated many of the terms used by a mining engineer in describing the geography of a mine are very confusing, as he uses common words to explain quite special conditions; but with the help of this book he (the uninitiated) should soon appreciate the significance of the terms, for the author goes beyond the scope indicated by the title and covers a fairly wide field. He explains, for instance, the process of preparing the plans of mines and their correlation with maps of the surface, the construction of contour models and the surveying of bore holes. There is a chapter on faulting and folding and another on triangulation, while the main subject is dealt with under the heading Applied Geophysics. In this section the author explains how the position of mineral deposits may be traced through their effect of instruments employed in their vicinity on the surface. The book should appeal not only to those interested in mining, as much of the reading matter applies to other branches of surveying.

Foundry Practice. By R. H. Palmer. London: Chapman and Hall. 1926. 15s.—This work is now in its third edition and has been partly re-written and enlarged. Modern moulding machines, such as the sand slinger and labour-saving devices are, for instance, described in some detail. The latter class includes elevators for filling large flasks with sand, continuous moulding and pouring systems and apparatus for delivering cores to the moulder from the core room. The author has also added some tables and formulæ used in brassfoundry practice. The book is based on American practice, but it is eminently practical and full of useful hints.

Belt Conveyors and Belt Elevators. By F. V. Hetzel. London: Chapman and Hall. 1926. 25s.—This is the second edition of Mr. Hetzel's work, which deals exclusively with American practice, and it does not differ very greatly from the first edition, although more emphasis is put upon the importance of using idler pulleys with anti-friction bearings. The book is divided into two sections, the first dealing with conveyors, while the second is concerned with elevators, and in this part there are described some new forms of buckets. No attempt is made to describe complete installations, but rather to give details of the component parts. The book is profusely illustrated by good line cuts and tolerably good half-tone blocks.

BOOKS RECEIVED.

Superannuation Schemes. London: The Industrial Welfare Society, 51, Palace-street, S.W. 1. Price 2s. 6d. net.

Sewage Treatment and Disposal. By G. M. Flood. London: Blackie and Son, Ltd., 50, Old Bailey, E.C. 4. Price 10s. net.

Jahrbuch der Brennkrafttechnischen: Gesellschaft E.V. Sechster Band, 1925. Halle (Saale): Wilhelm Knapp. Price R.M. 4.

Bodybuilding in Aluminium. London: The British Aluminium Company, Ltd., Adelaide House, King William-street, E.C. 4.

The Use of Power in Colliery Working. By J. Kirsopp. London: H. F. and G. Witherby, 326, High Holborn, W.C. 1. Price 40s. net.

Engineering Factory Supplies. By W. J. Hiscox. London: Sir I. Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 5s. net.

Proceedings of the Institution of Mechanical Engineers. 1926. Volume I. London: The Institution of Mechanical Engineers, Storey's-gate, S.W. 1.

Elektrische Zündung, Licht und Anlasser der Kraftfahrzeuge. By Dr.-Ing. E. Seiler. Germany: Wilhelm Knapp, Halle (Saale). Price 7·60 marks.

Zusammenfassende Darstellung von Schraubenversuchen. Von Dr. Ing. Wilhelm Schmidt. Berlin N.W. 7. V. D. I.-Verlag, G.M.B.H. No price stated.

History of the States of Guernsey Telephone System (1895–1925). By A. Roeling Bennett. London: Leonard Parsons, Ltd., 24, Devonshire-street, W.C. 1. Price 5s. net.

Gears and Gear Cutting. Previously "Toothed Gearing." By J. Horner. Revised by P. Gates. London: Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4. Price 5s. net.

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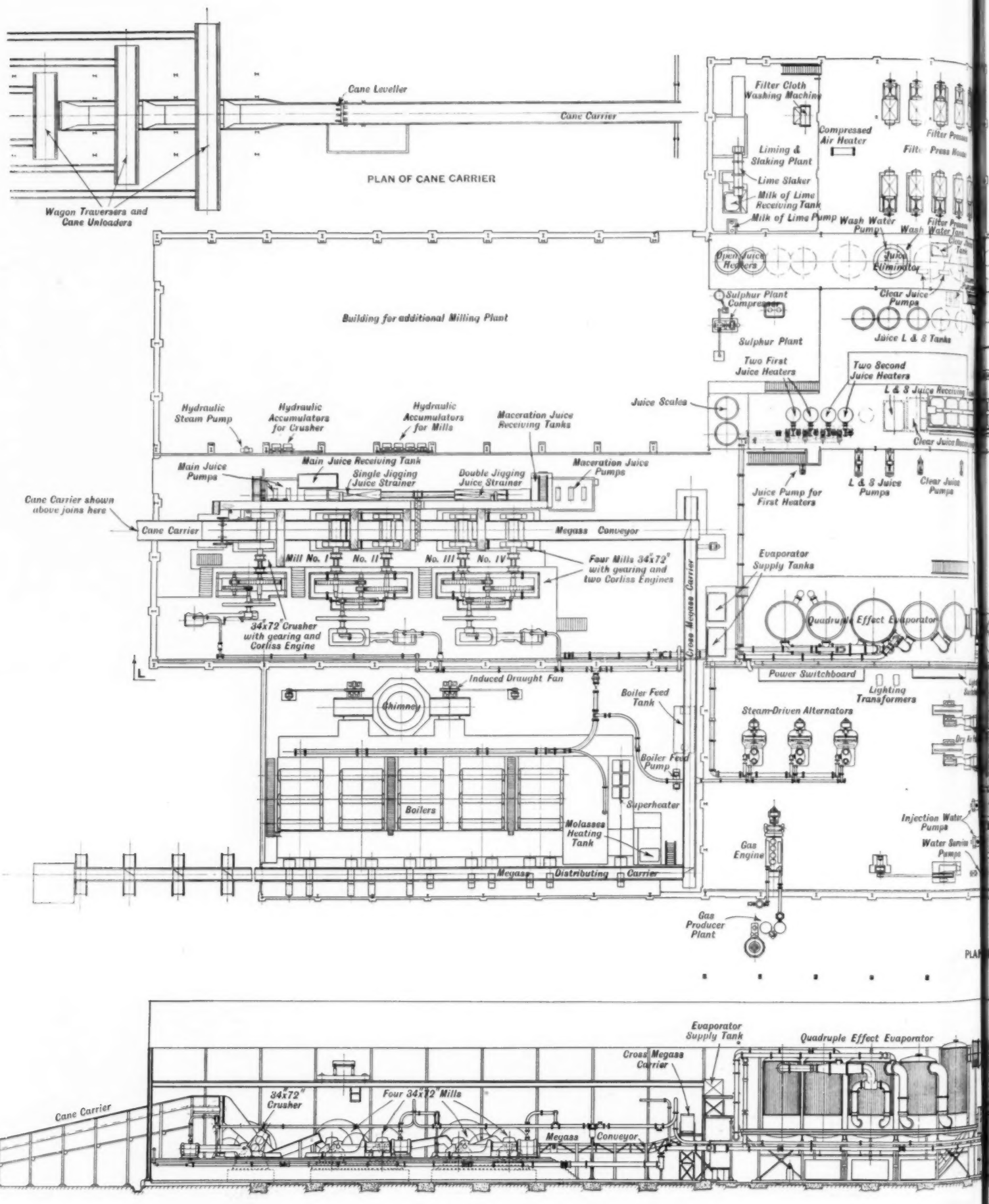

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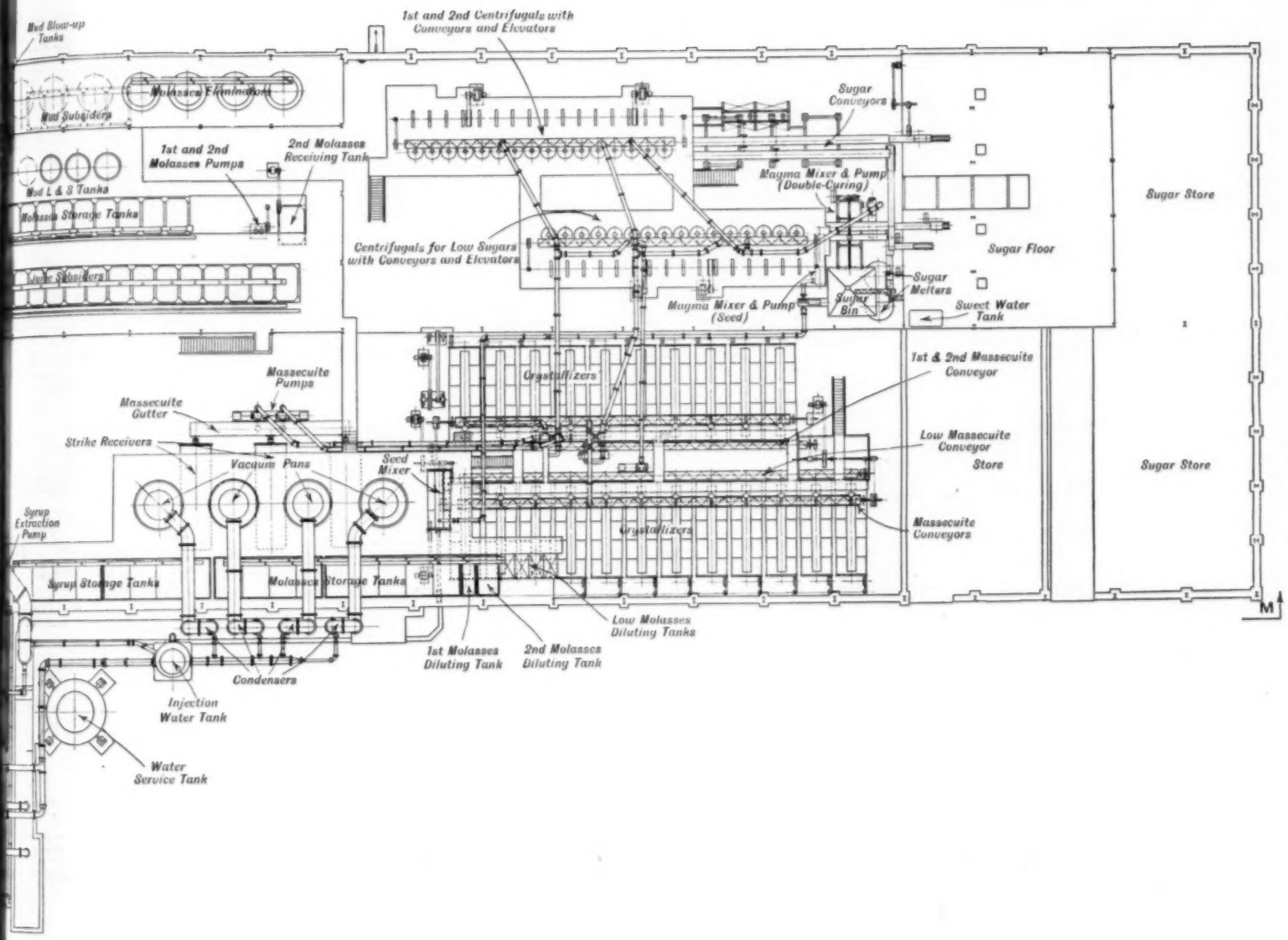

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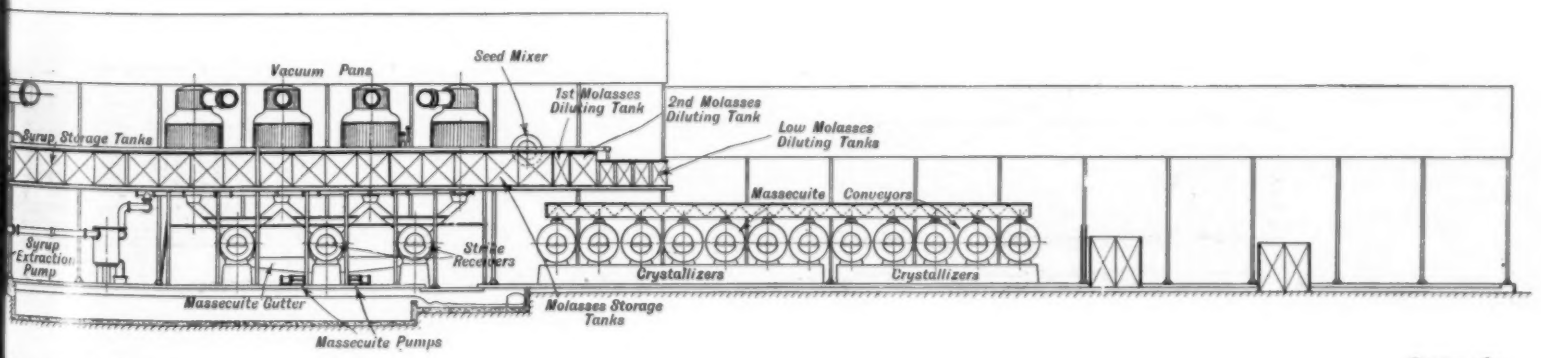


ELEVATION AT L. M.

SWAIN Sc.

UNIV. OF MICH.

The World Power Conference at Basle.

No. IV.*

When Section C, which covered the Economic Relation between Electrical Energy Produced Hydraulically and Electrical Energy Produced Thermally, re-assembled on September 9th, under the chairmanship of Professor Elvio Soleri, after some opening remarks by the General Reporter, Monsieur Buchi spoke on the utility of the Diesel engine in conjunction with hydro-electric installations for taking peak loads or for standby purposes, giving estimates of capital and running costs to prove his contentions.

Messrs. Neeser, Meyer, and Ehrensperger then spoke briefly.

Monsieur Arbelot pointed out that the figures given in the report relating to costs in France, referred to conditions existing at the beginning of 1925. The assistance of thermal stations to hydro stations was always considered as being necessarily of a periodical nature, the steam stations taking the daily peaks. There was another point of view which the speaker had regarded in his report, namely, that of the use of thermal stations for continuous assistance. The market price of a kilowatt-hour was at present so low that hydro-electric stations were only economically possible if assured of a reasonably large output. Hence steam stations played a useful part in giving a supply until conditions justified the construction of a hydraulic plant. Another point to be remembered was that the capital sunk in large transmission lines was so great that at the present time the lines could not be constructed unless assured of a sufficient load. Hence the use of lines to serve electrified railways as well as industrial purposes was very important.

After some remarks by Monsieur Von Miller, Dr. Kano said that in Japan they had about 14 million water horse-power available, but they were rather short of coal. There was enough coal for present demands, but it would be exhausted in the not far distant future. The base load was therefore generally taken care of by hydraulic power, and steam power was used to take the peaks. The steam station also came into operation at times of low water. With a water power plant the cost was about 500 to 800 yen, while the cost for a steam plant was only 150 to 200 yen per kilowatt. Thus the capital outlay on water power plants was more than three times that of equivalent steam plants, and for that reason it was not possible to develop economically, at present, more than 25 per cent. of the available water power in the country. Nevertheless, the demand was increasing day by day, and trunk transmission lines were to be constructed to link up various cities and thus equalise the load. One of the difficulties in the way of that project was the fact that in North-East Japan the frequency was 50 cycles, whereas in Western Japan it was 60 cycles.

Dr. S. Yamaguchi mentioned that in Japan it was found necessary to have thermal plants with a capacity about 30 per cent. of the hydro-electric plants, in order to take care of peak loads or of times of low water. For the present cost of a 10,000-kilowatt hydro-electric plant with a 60 per cent. load factor Dr. Yamaguchi gave the capital cost of the station complete, but excluding transmission lines, as 550·00 yen. The running costs were:—Interest, 8 per cent. = 44·00 yen; depreciation and repairs, 2·5 per cent. = 13·75 yen; maintenance, oil, wages, &c., at 1 per cent. = 5·50 yen; making a total operating cost of 63·25 yen. For a corresponding steam plant the capital cost was 170·00 yen per kilowatt. Interest at 8 per cent. amounted to 13·60 yen; depreciation and repairs at 7 per cent. to 11·90 yen; coal to 31·50 yen; other costs at 7 per cent. to 11·90 yen. Thus for the steam plant the running cost was 68·90 yen per kilowatt-hour. The coal bill was calculated at the rate of 7·50 yen per ton and 0·80 kilos. per kilowatt-hour for coal of a calorific value of 5600 calories per kilogramme. The balance thus came out in favour of hydro-electric installations, but for a lower load factor or as a standby plant the steam station was the more economical. There was, however, always the question of the conservation of the coal supply of the country to be considered, and it seemed better to develop hydro-electric power even at the expense of economy. It might be possible to utilise subterranean heat in Japan; at any rate, the prospects were encouraging.

Mr. W. H. Patchell said that the assistance required by hydro-electric plants was becoming a very important question, and whether oil or coal should be the fuel was a minor matter. In the United States the steam turbine makers found that some of their best customers were the hydro-electric companies. If electricity were used as it might be there would not be enough water power to go round. In Switzerland the power consumption amounted to about 1000 kilowatt-hours per head per annum. By judicious rates, such as a fixed charge plus a low price per kilowatt-hour, private consumers might approach such consumptions per head, provided they used electric cookers, electric irons, electric boilers and refrigerators. Even without the electric boilers and refrigerators the private consumption might reach 500 kilowatt-hours per head per annum. Mr. Buchi was quite right in claiming a high standard of efficiency for the Diesel engine. The oil engine ranked very high in thermal efficiency. As much as 32 per cent. of the heat of the fuel could be turned into work in a modern oil engine, while in the Still engine the proportion was 39 per cent.

Monsieur Buruiana said that besides the reasons for the collaboration between thermal and hydro-electric stations which had been given, such as security of supply, cheapness of total cost, &c., there was also another factor to be considered. It was the desire of certain States to economise their fuels. Thus in Roumania the law encouraged by special legislation the construction of water power stations, while it only permitted the construction of thermal stations when the latter were absolutely necessary. The intention of the law was to limit the construction of steam stations to cases of reserve or standby.

Monsieur Magnier said that in most cases one seemed to imagine the duty of thermal stations to be that of taking the peaks of the load on a water power system. That did not appear to be quite correct. Reference to a table given in Monsieur Arbelot's report would show the great difference in cost per thermal kilowatt-hour, according to the length of time the station was running per year, and one saw that if the time of service varied from 5000 down to 1000 hours the cost was doubled. It might be worth while in many cases to equip hydro-electric stations to take the peak, to avoid this great increase in cost. Extra equipment for the peak would only be necessary in some of the stations of a large grouped system. Thermal stations were necessary to sustain the output during periods of low water. He came to the conclusion from this reasoning that the function of a thermal station was to make up the insufficiency of the hydro stations, not at the times of peak load, which could be done by water storage and extra equipment, but merely by furnishing the wanted kilowatt-hours. The electro-chemical industries on a large system could help in economical power production by diminishing their consumption during certain periods when power was short.

SECTION B.

Section B met for the first time on Monday afternoon, September 6th, under the Presidency of Monsieur Legonez, to discuss the Exchange of Electrical Energy Between Countries. The six papers presented to the Section had been summarised by Professor Landry, whose report we give in abstract below.

EXCHANGE OF ELECTRICAL ENERGY BETWEEN COUNTRIES.

By Professor Landry (Lausanne).

The exchange of electrical energy between countries is a special case of international exchange, its highly specialised character being given to it by everything relating to the production, transport, distribution and manifold applications of this weightless commodity, electricity.

If no account is taken of arrangements of a strictly local character, and which in the main have very little influence, as, for example, the exchange of electrical energy between France and Belgium, Luxembourg, the Saar district, Italy and Spain, it is found that exchange of any importance takes place only between the following countries or groups of countries:—

(1) Between Switzerland and Germany, France and Italy.
(2) Between Sweden and Denmark.
(3) Between Canada and the United States.

On the map of the world these appear only as scattered islands, and it can be stated without exaggeration that from a geographical point of view the exchange of electrical energy is still in the very earliest stages of development.

We should have liked to give a detailed picture of the examples of energy exchange at present in operation, but owing to the lack of sufficient statistical data relating thereto, we are forced to limit ourselves to the following few particulars.

Switzerland is a country possessing superfluous water power, and is very highly electrified—97·5 per cent. of the population live in districts having distribution networks for electrical energy—so that it is undoubtedly an exporting country. Moreover Switzerland has been in this position for about twenty years, during the course of which the export of energy has increased to such an extent that during 1925 it amounted to about 650 million kilowatt-hours, *i.e.*, approximately 20 per cent. of the total energy produced. Of this, about 300 million kilowatt-hours, *i.e.*, about 46 per cent. of the Swiss export, were taken by France, an importing country, of whose total energy production it amounted to about 3 per cent.

Canada, also rich in water power resources, has exported power to the United States ever since the first power station on the Canadian side of the Niagara Falls was put in operation. It is seen from a tabular summary appended to the report of Mr. Kelly—No. 73—that during the last sixteen fiscal years, 1911–1926, the Canadian export companies supplied altogether 14·2 thousand million kilowatt-hours to the United States, *i.e.*, about 35 per cent. of the 40·7 thousand million kilowatt-hours produced during that period by the exporting companies. In 1911 the exported energy amounted to 540 million kilowatt-hours out of a total production of 800 million—67·8 per cent.—and in 1926 it amounted to 1·36 thousand million kilowatt-hours out of a total production of 4·935 thousand million—27·5 per cent.

Finally, authority was given in 1914 for Denmark to import electrical energy from Sweden by means of submarine cables. The report of Mr. Krarup gives no figures that might give an approximate idea of the importance of this exchange. He limits himself to stating that twenty-five Swedish and Danish power stations operate on a common system, having a total capacity of 150,000 kilowatts.

It will be seen from the foregoing that the statistical data concerning the international exchange of energy is very briefly summarised, and is difficult of comparison, because of certain points being omitted, or owing to the various bases on which the particulars given are founded. All that one is able to gather from the scanty information obtained here and there is that Canada, with a population of 9,000,000—1924—exports annually about 155 kilowatt-hours per head, as compared with the 900 kilowatt-hours, approximately, consumed within her own borders under the same conditions. Switzerland, with a population of 4,000,000, exports about 166 kilowatt-hours of every 700 produced; and France imports about 7 kilowatt-hours of every 250 consumed. It should have been possible to draw a comparison between these figures and the capabilities of the countries to produce and consume the energy; the data concerning production, however, are missing, and the estimates which must be made regarding consumption are too uncertain to allow of any discussion in this connection.

Difficulties.—The energy exchange problem would be greatly simplified if it were merely dependent on free trade principles, and if the bargain only concerned the supplier and customer, and could be concluded without reference to considerations other than those of a commercial or international character.

The fact remains that there are numerous difficulties, small and great.

Of these, some are due to the laws governing international trade, or rather to the lack of some unified form of agreement on this subject. The question was analysed and discussed by Dr. Trümpy in an extremely interesting report on the legal aspects of the case. In this report the author came to the conclusion that in view of the extremely complicated and intricate legal questions involved, the parties concerned should conclude their own agreements, to be completed in arbitral conferences where the composition, method of appointment and business of the arbitration courts thus established are precisely laid down. The above author also deals with the difficult and unfortunately very real question of the exchanges which has also been touched upon by his compatriot Mr. Niesz—report No. 59—who attempts to supply an equitable and inexpensive formula.

Others, and these are not least, depend on the public law in the various countries with its by-laws, provisions and decrees, not forgetting in a few countries, at least, the influence of Governments solicitous for national balance.

There are no ordinary means, which, by the application of general rules, enable an estimate to be made of different trade agreements. Each is the result of special circumstances which must be very exactly known before one can say whether they are in the public interest or not. There are also those which make use of danger or competition from abroad and of the possibilities of utilisation. These are merely chimeras. Finally, there is the influence of nearly all the legal enactments and decrees by which the various Governments attempt to safeguard the public interest, although this would appear to be already sufficiently guaranteed by all the conditions and obligations by which the concessionnaires are bound, not to mention the many regulations which accompany the authorisations to carry out the work. It might be well to take a survey of these.

Conclusions and Aspirations.—The international exchange of electrical energy is at present in its infancy and only takes place between adjacent countries. Its efficacy is proved beyond doubt, and one can only wish that the connecting lines could be developed to make it possible. What should be done, in fact, is to support everything that aims not only at an intensive utilisation of natural sources of energy, but also at a uniform utilisation.

Nature has not distributed her wealth at all uniformly, and it is necessary therefore that what can be only imperfectly carried out within political boundaries should be attained wherever possible by the exchange of energy between countries, which, from the point of view of power resources, are supplementary.

From an economic and technical point of view, everything speaks in favour of the exchange of energy between countries. Everything possible must be done therefore to develop this exchange.

Above all, great exertion and goodwill are required, and these chiefly in engineering circles, where much yet remains to be done to complete the work of standardisation and to fix the means of testing. Statistical data, which, as we have seen, are entirely lacking, should be collected. They should have reference to everything concerning the sources of energy available throughout the world, of which, to obtain as great a utilisation as one is justified in expecting, analogous estimates should be made in all countries. Endeavours should be made to standardise the voltage of transmission lines and tests regarding same, involving such delicate problems as the parallel working of systems, &c.

In order, however, that the endeavours of engineers shall prove fruitful, it is principally necessary that corresponding exertions shall be made on the part of the Governments concerned, as everything rests with them.

The discussion was opened by Professor Landry, who, speaking on the question of the quantities of power exported and imported by different countries, said that Switzerland supplied power to three of the four surrounding countries. In 1925 that country exported about 650 millions of kilowatt-hours, or 20 per cent. of the total production. France imported about 300 millions of kilowatt-hours, or equivalent to about 3 per cent. of the total consumption. Canada, according to Mr. Kelly's report, exported to the United States in 1921, 540 millions of kilowatt-hours out of a total of 800 million generated, or an exportation of 68 per cent. In 1925, the exportation was 1·36 milliards of kilowatt-hours, or 27 per cent. of the total. There was thus a progressive diminution in the proportion of power exported. Canada, with its 9 million inhabitants, exported about 155 kilowatt-hours per head per annum, against 900 kilowatt-hours consumed on its own territory, while Switzerland, with its 4 million inhabitants, exported about 160 kilowatt-hours, as against 700 kilowatt-hours consumed. On the other hand, France, as an importing country, imported 7 out of 250 kilowatt-hours consumed per head of population. It was to be noted that the Province of Quebec had passed a law in March of this year, totally prohibiting the export of electric power from that moment, and also forbidding the construction of transmission lines to serve foreign countries.

Monsieur Genissieu, mentioned that instead of the exchange of power between France and Germany being in balance, as he had thought, there was a considerable excess of importation by France. The importation reached 54 millions of kilowatt-hours per annum, and the exportation 15 millions. In connection with the exchange of power between France and Switzerland it was notable that the French importation was largely the summer excess. During recent winters there had been a small exportation of thermal power from France to Switzerland. It was possible that Switzerland would import more and more thermal power during the winters.

Monsieur Niesz mentioned that in Switzerland, before the exportation of power was legalised, it was necessary to apply to the Government, which opened an inquiry, and if permission was granted, rules were laid down as to the conditions to be observed. The procedure took weeks or months, and was very harmful to business, especially when the power in question was only of a temporary nature.

Mr. Kitada said that the exchange of electrical

* No. III. appeared September 24th.

energy on the China-Japanese frontier was, with some exceptions, a matter for the future, when possibly it might become important. In the Far East the joint management system for electric enterprises was coming largely into use. Under that system, which might be applied to countries, municipalities or individuals, one found natural resources utilised on a judicious basis.

Monsieur Arbelot pointed out that there were two aspects to the question of exportation of energy. If two adjoining countries wished to exchange their services, at times when one had a demand for power and the other had a surplus capacity, it was undoubtedly a sound proposition. On the other hand, the question of a continuous export of electricity from one country to another had less evident advantages, and the dangers to which the importing country would be subjected were much more evident than when the service was reciprocal. It must also be remembered that the importation of electricity might do harm to a country by hindering the development of its own natural resources.

The Chairman remarked that the distinction emphasised by the last speaker had been recognised in the reports. The condition which justified the exportation of electricity was certainly the state of affairs in which available power would be lost to everybody if it were not exported.

Monsieur Landry thought it would be important if the Congress would express the definite opinion that exchanges of electricity between countries ought to be encouraged; at any rate, when such exchanges would result in the best utilisation of the power by all concerned.

Monsieur Brylinski realised the desire of the assembly to come to some unanimous conclusion. He thought that the motion of Monsieur Landry could be accepted, without traversing the point of view of Monsieur Arbelot. If the exchange of electricity were to be endorsed "in principle" everybody would be in agreement, as particular cases would then be excluded.

The Chairman referred to the recent decision of the Congress at Grenoble last year, when the opinion was expressed that all new contracts for the exportation of electricity should be submitted to the approval of the Minister of Public Works. That arrangement in no way hindered importation or exportation, but it demanded simply that commerce of the kind should be submitted to certain formalities in order to avoid certain difficulties.

Monsieur Schlumberger said the danger to be avoided was really that of too much legislative interference. A World Power Conference ought certainly to get it into its head that the best resolutions it could pass would be those tending to increase the facilities of exchange. No resolution should be passed which would encourage lawyers to put up more barriers than existed at present.

Mr. Theodore Rich said the exportation of thermal power from France to Switzerland was extremely interesting. Now that voltages of 120,000, 150,000 or even 240,000 volts were practicable, it might be cheaper in many cases to send power into another country by means of a wire, than by means of coal in trucks. That point of view became increasingly important when the fuel was lignite, which would not stand long distance transportation.

Messrs. Haas and Von Miller also spoke.

When the sitting was resumed on Tuesday afternoon, under the chairmanship of Professor Busila, of Bucharest, Monsieur Landry said that he noted a strong desire for international collaboration which would tend to diminish the difficulties of international electrical connections. Monsieur Krarap, in his report, had explained the conditions governing the exportation of electricity from Sweden to Denmark. The incoming energy was subject to a tax of 7½ per cent. of its price. Monsieur Krarap had also envisaged a great project for the transmission of Norwegian electricity to Denmark by way of Sweden.

After remarks by Monsieur Krarap, who said the Danish authorities were always ready to welcome all inventions and discoveries which engineers might make with the object of faciliating the use of electric power, and short speeches by Monsieurs Angelo and Haas.

Monsieur Landry said that in discussions on power he strongly supported the recommendations of the International Electro-technical Commission, that the limit of power should be the kilowatt, whether the power of a turbine or of an alternator was in question. He had noticed that in the reports from various countries the term "horse-power" tended to become general. That had led to errors in printing; for example, the 4 millions of horse-power installed in four provinces of Canada were stated in the report as 4 millions of kilowatts. He did not desire international legislation on the exportation of power any more than on any other matter. It was always extremely difficult to formulate resolutions, but he thought the World Power Conference at Basle might go on record as desiring that national and international interconnections would facilitate greatly the more rational use of the sources of energy in the world, and that the question should be approached by Governments in a spirit of true liberalism. The Conference, he hoped, would also express the opinion that concerted action should be taken to get statistics of world sources of energy on a uniform basis, and to standardise the voltages of high-tension transmission lines. After some discussion a resolution to this effect was carried unanimously.

Before closing our account of the Conference, it is only fair to the Swiss Committee to mention some of the arrangements made for the comfort and entertainment of the visitors. The latter on arrival at the station found badged interpreters ready with all information, and an office where hotel accommodation could be arranged for by those who had not availed themselves previously of the organisation for that purpose. In spite of the multitude of nations represented, we did not hear of a single complaint of the way daily information was provided as to visits, excursions, &c. Among the entertainments for the visitors were an official banquet to celebrate the opening of the Congress, a visit to the Rhine Harbour at Basle, including a view of the town and the three countries surrounding it from the top of a grain elevator 160ft. high. The Government of Basle also welcomed the delegates at a reception given in the Rathaus. The Augst Power Station, near Rheinfelden, the Zoological Gardens at Basle, the Amsteg Power Station were also visited. The Swiss Federal Railways invited the delegates to an excursion to the St. Gothard by a special train. On Wednesday, the day of the termination of the Conference, the delegates went, some to Zurich to visit the works of Messrs. Sulzer Brothers, and others to Baden, to visit those of Brown, Boveri and Co. Following these visits a series of excursions through Switzerland was arranged, the services of Messrs. Thomas Cook and Son being utilised in this connection. The organisation of the Conference throughout was admirable, and reflects great credit on the Swiss Committee, and particularly on the organising secretary, Dr. Carl Huebscher.

Stresses in Cast Iron Pipe Sockets.

This article deals with an investigation made by Mr. R. G. Batson and Mr. W. F. Cope in the engineering department of the National Physical Laboratory at the request of the Sub-committee on Cast Iron Pipes for Water, Gas and Sewage of the British Engineering Standards Association.

The thickness of the sockets of the existing B.E.S.A. standards are regarded by many water engineers as excessive, and as adding unnecessarily to the weight and therefore to the cost of pipe lines. An investigation was therefore undertaken to estimate the stresses produced by caulking and internal pressure in (*a*) a pipe socket to the B.E.S.A. specification, (*b*) a pipe socket of lighter design which had been used with complete satisfaction in a large installation. The cast iron pipes had internal diameters of approximately 25in., and dimensions of the two types of sockets are given in Fig. 1. The stresses in the pipe sockets were estimated from measurements of the increase in the external diameters produced by caulking and also by internal water pressure up to 325 lb. per square inch.

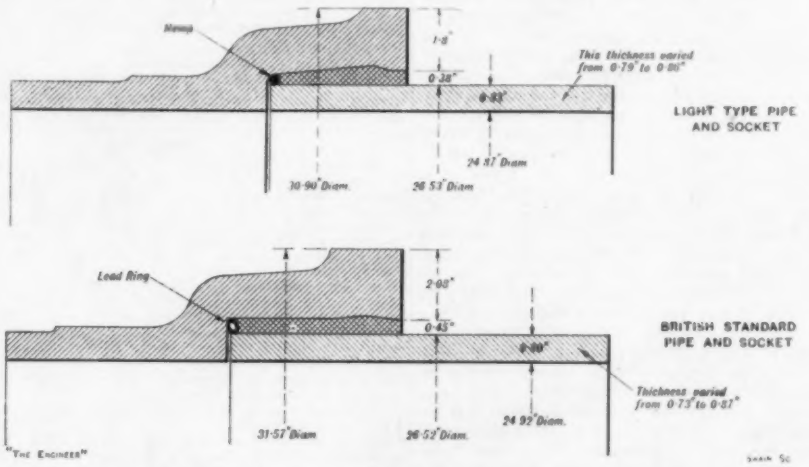


FIG. 1—LIGHT TYPE AND B.E.S.A. STANDARD PIPES AND SOCKETS

The following methods of caulking were used with each type of socket:—(1) Run lead, hand caulked; (2) run lead, machine caulked, pneumatically; (3) "woolly" lead, hand caulked; (4) "woolly" lead, machine caulked, pneumatically. The running of the lead and the hand caulking were carried out by a pipe jointer and his mate, sent to the Laboratory by Mr. H. E. Stilgoe, chief engineer of the Metropolitan Water Board. The "woolly" lead joints were caulked with tools specially supplied for the purpose and by men who had had considerable experience with caulking this type of joint. The run lead joints were caulked with tools 1in. wide and of the following thicknesses:—Chisel edge, $^{5}/_{32}$in., $^{3}/_{16}$in., ¼in. and ⅜in. For the hand caulking a 4 lb. hammer was used. The machine caulking was done by a fitter sent by Mr. G. M. Burt, of John Mowlem and Co., who also supplied the pneumatic caulking apparatus. This pneumatic caulker was marked "Ingersoll Rand Company, New York, London 'Imperial' Size 1, Series N. 690." The diameter of the shank of the tools was $^{11}/_{16}$in. and an air pressure of 80 lb. per square inch was used throughout. The lead and "woolly" lead were supplied by the Metropolitan Water Board.

All the tests were made on the same two sockets, the joint being cut out by a fitter from the Metropolitan Water Board between each test. No difficulty was experienced in cutting out the joints. The run lead joints were harder to cut out than the "woolly" lead joints. Unfortunately, the spigot of the light type socket was cracked in cutting out the last joint but one, and the last test on this type of socket was made with the spigot which had previously been used for the B.E.S.A. socket. Both spigots were of approximately the same size, so that the results are comparable.

The Stanton Ironworks Company supplied the castings for the apparatus, pipe ends and sockets and cast iron tensile test pieces free of charge.

Method of Test.—The apparatus used is shown in Fig. 2. For the initial measurements of the socket the test pipe B was held centrally in the socket by means of wooden wedges, which were removed when the caulking was carried out. The test pipe and socket were supported by means of the end plates and cast iron ring R and the weight of the apparatus was taken through the shaft H on to the two vee blocks C and D. By means of the india-rubber rings F a water-tight space was formed for the application of internal pressure to the pipe. This pressure was applied through the inlet N, while an air outlet was arranged at O for the initial filling of the chamber with water. The principal feature of the test was the measurement of the alteration of the distance between the outside of the test socket and a cast iron measuring ring E. The measuring ring E was located on the test socket by means of a 10 mm. diameter ball T and was pulled up into contact with the test socket through this ball by means of lifting tackle. A spring balance V was interposed between the measuring ring and the lifting tackle in order to ensure that the contact pressure was the same in all cases. The spring balance reading was always kept at 250 lb., the major part of this load—about 160 lb. —being due to the weight of the ring, and the remainder representing the pressure on the locating ball. The alteration of the distance between the outside of the socket and the cast iron measuring ring—*i.e.*, the alteration in diameter of the socket—was measured in three ways:—(*a*) By a special level arrangement. (*b*) By means of a depth gauge. This was used as an approximate check on the level arrangement, and in order to give values should the amount of expansion be so large as to bring the readings outside the range of the level. (*c*) By means of a special arrangement of mirrors, rhomb and telescope. This gave a further approximate check on the level readings and also an indication of change of slope of the end of the socket.

Level Arrangement.—The arrangement of level used is shown in Fig. 3. This arrangement required the use of three balls forming a triangle, the base of the triangle subtending an angle of about 170 deg. One ball—the ball at the apex of the triangle—was embedded in small plates attached to the socket by small screws and locating pins, while the other two, forming the base of the triangle, were fixed in the cast iron measuring ring. Any relative movement between the cast iron measuring ring and the socket, therefore, tilted the level and the amount of this tilt was measured.

In order to eliminate the effect of any disturbance in the level of the apparatus as a whole, two further balls were embedded on the measuring ring, as shown at P—Fig. 2. There were thus two triangles with the ball, which was embedded on the small plates attached to the socket, as the common apex. Level readings were taken in both directions and the mean

value used. The elimination of the effect of alteration of the general level of the apparatus was thereby obtained. By the use of this apparatus the pipe and socket could be dismantled and reassembled, and any alteration of the external diameter of the socket measured to an accuracy of ± 0·00005in. Apart from errors introduced by dismantling, readings on the same diameter could be obtained to ± 0·00001in.

Depth Gauge Measurements.—These measurements were obtained by holding a micrometer depth gauge of the ordinary workshop type on the measuring ring and reading the depth between the ring and the top of the small plates attached to the socket. Readings were obtained on either side of the "apex" ball, and the mean value used for the purpose of the test. These readings are not to the same high degree of accuracy as the level readings, and were only recorded as an approximate check on the latter observations.

Mirror Measurements.—This arrangement is shown diagrammatically in Fig. 4. With the level arrangement the "apex" ball was in the plane C C, which included the end of the socket. For the mirror observations a small rod R was screwed into the plate M, so that the point A was 1¾in. from the plane C C. A plate E E was attached to the measuring ring and fixed to this plate was a flat spring plate B D. Small grooves were made on the rod R at A, and on the spring plate at B and a small diamond-shaped rhomb F was placed in the grooves A and B.

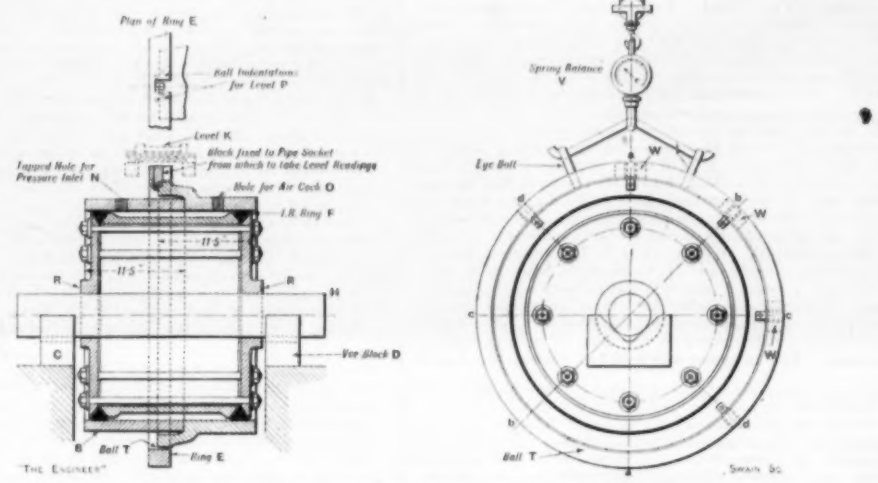


FIG. 2 APPARATUS FOR TESTING EXPANSION OF PIPE SOCKETS

Any relative movement between the measuring ring and the plate M, and therefore the socket, caused B to move relatively to A with a consequent tilting of the rhomb F. The amount of this tilting, and therefore of the movement of the socket relative to the measuring ring, was measured optically. A mirror G was attached axially to the rhomb and the rotation of the mirror, and therefore of the rhomb, was measured by means of a scale S and telescope T. The size of the rhomb and scale distance 36in. were arranged so that a reading of 1 mm. on the scale corresponded to a movement of 0·0001in.—one-tenth of a millimetre could be estimated on the scale. The plate E E also contained a fixed mirror H which focussed the same scale S into the same telescope T. Two scales were therefore visible in the telescope, side by side. By this means a correction could be applied to the results to allow for any alteration of the position of the measuring ring relatively to the telescope in a vertical direction. If the end of the socket K L remained in the same plane throughout the test, the readings given by the level and mirror arrangements would be the same. Any tilting of the end of the socket K L would cause the mirror readings to be either greater or less than the level readings according to which way the tilting took place.

Test Results.—A preliminary test was made with the light type socket using run lead and hand caulking. The results indicated that the initial stress set up by caulking at the outside of the socket did not remain constant, but gradually fell off with time, becoming approximately constant after about seven days. After applications of internal pressure, the stress further decreased until after about fifty applications of pressure—0 lb. to 325 lb. per square inch—the value again became constant.

As a result of this preliminary work the full series of tests was carried out under the following conditions:—The sockets were measured on four diameters, *a a*, *b b*, *c c*, and *d d*—Fig. 2. The increase in diameter was measured about three hours after caulking, and also daily for from seven to ten days. By that time the measurements were approximately constant and internal pressure—0 lb. to 325 lb. per square inch—was then applied. After fifty applications of this range of pressure, a series of observations was taken at various pressures up to 325 lb. per square inch.

The results of the tests are summarised in Table I., and are plotted in Figs. 5 and 6. The figures plotted are in each case the average of the four diametral readings. The stresses in Table I. were obtained in the following way:—If D = original diameter of the socket, and d = increase in diameter of the socket; then $\frac{d}{D}$ = the strain. The stress corresponding to this strain was obtained from the tensile stress-strain curve given in Fig. 7. This stress-strain curve was plotted from the tensile test results given by a test piece from the same cast as that employed for the pipes and sockets.

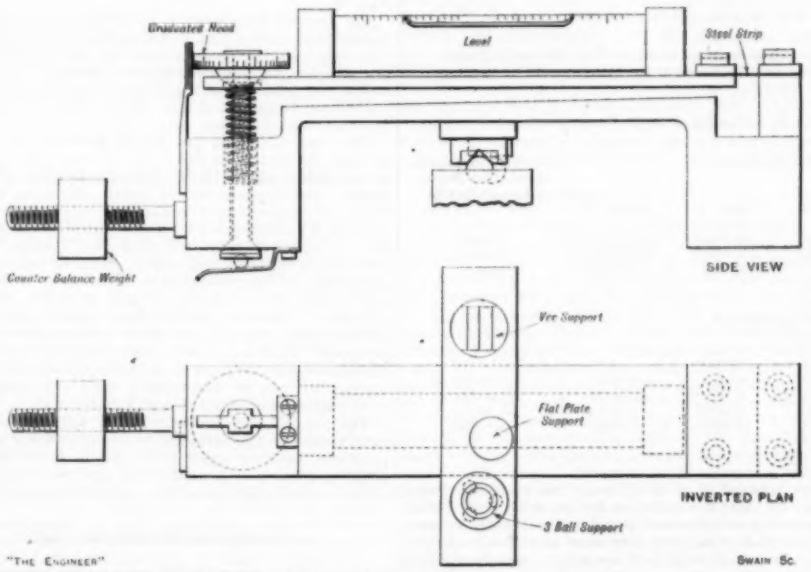


FIG. 3—LEVEL ARRANGEMENT FOR MEASURING EXPANSION

The initial depth gauge readings taken before each test, *i.e.*, before the joint was made, gave an indication of the amount of permanent increase in the diameters of the sockets since the commencement of the tests. The amounts of these increases are given in Table II. It will be noted that the B.E.S.A. socket increased 0·0022in. as the result of three caulkings, while the light type socket gave an average permanent increase of 0·0069in. for five caulkings. Estimating from the permanent strains given in Fig. 7 and the maximum stresses applied to the sockets, the permanent increases in diameter for the two sockets should be 0·0013 and 0·0029, instead of 0·0022 and 0·0069, which were obtained. The difference between these figures was probably caused

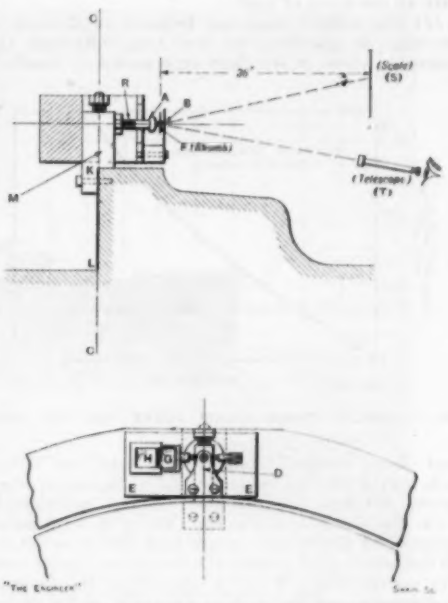


FIG. 4—MIRROR ARRANGEMENT FOR MEASURING EXPANSION

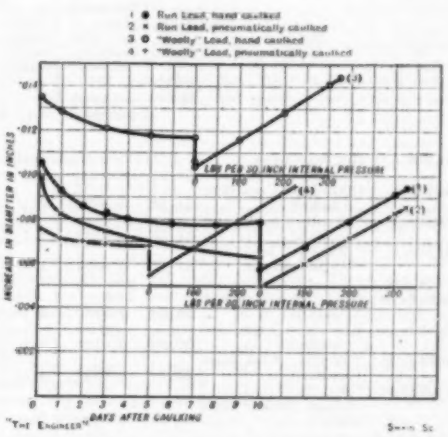

1 ● Run Lead, hand caulked
2 × Run Lead, pneumatically caulked
3 ⊙ "Woolly" Lead, hand caulked
4 + "Woolly" Lead, pneumatically caulked
INCREASE IN DIAMETER IN INCHES
LBS PER SQ INCH INTERNAL PRESSURE
DAYS AFTER CAULKING
"THE ENGINEER"
SWAIN Sc.

FIG. 5—EXPANSION OF B.E.S.A. STANDARD SOCKETS

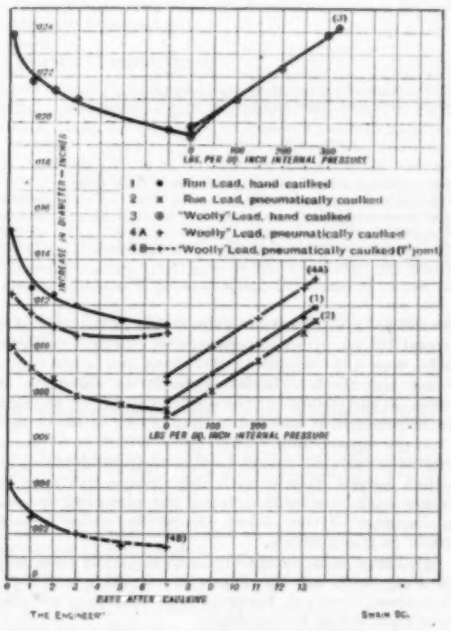

1 ● Run Lead, hand caulked
2 × Run Lead, pneumatically caulked
3 ⊙ "Woolly" Lead, hand caulked
4 A + "Woolly" Lead, pneumatically caulked
4 B +··· "Woolly" Lead, pneumatically caulked (F" joint)
INCREASE IN DIAMETER — INCHES
LBS PER SQ INCH INTERNAL PRESSURE
DATE AFTER CAULKING
THE ENGINEER
SWAIN Sc.

FIG. 6—EXPANSION OF LIGHT TYPE SOCKETS

by the strains applied to the sockets when the joints were cut out.

Remarks on the Tests and General Conclusions.—(1) The stresses in the light type socket caused by caulking were higher than those in the B.E.S.A socket with all the types of joint.

(2) The sockets were not broken—as a result of caulking or pressure—in any case, although the estimated stress in the light type socket—"woolly" lead, hand caulked—reached 4·6 tons per square inch. This stress apparently had no injurious effect on the socket as the subsequent test was satisfactory.

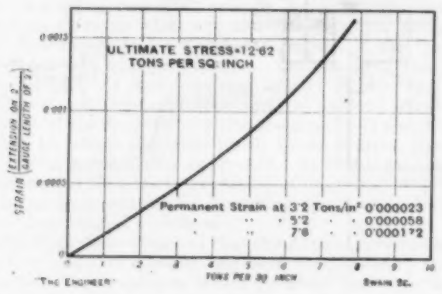

ULTIMATE STRESS=12·62
TONS PER SQ. INCH
Permanent Strain at 3·2 Tons/in² 0·000023
" " 5·2 " 0·000058
" " 7·6 " 0·000172
STRAIN (EXTENSION ON 2" GAUGE LENGTH OF 8")
TONS PER SQ. INCH
"THE ENGINEER"
SWAN SC.

FIG. 7—TENSILE STRESS-STRAIN CURVE FOR CAST IRON

(3) The stress in the socket caused by an internal pressure of 325 lb. per square inch was constant for all the tests and of a value of 0·8 tons per square inch. The curves—Figs. 5 and 6—show that the increase in diameter and therefore in the stress in the socket was proportional to the internal pressure. From theoretical considerations, the stress in the pipe itself caused by an internal pressure of 325 lb. per square inch, was approximately 2·2 tons per square inch. Using the thick cylinder formula to calculate the stress on the outside of the socket caused by the same water pressure it was found that it was of the order of 1 ton per square inch. This figure, which is, of course, only approximate owing to the irregular form of the socket agreed closely with the stress—0·8 tons per square inch—calculated from the observed increase in diameter of the socket caused by water pressure alone, as given above.

(4) There is a reduction in stress with time after caulking with all the types of caulking employed. The stress, however, becomes approximately constant after from seven to ten days.

(5) After application and release of internal water pressure, the stress in the socket is still further reduced and the value again becomes approximately constant after fifty such applications.

(6) The stresses in the sockets caused by caulking with "woolly" lead were higher than those when run lead was employed.

(7) The stresses in the socket with hand caulking were higher than those with machine caulking.

(8) Satisfactory joints were formed with run lead and machine caulking, *i.e.*, the conditions giving the lowest stress in the sockets.

TABLE I.—*Summary of Tests.*

Type of socket.	Method of caulking.	Outside diam. of sock't, inches	Average increase in diam. (3 hrs. after caulking), inches. No internal pressure.	Estimated stress, tons/in.²	Average increase in diam. 7 days after caulking, inches. No internal pressure.	Estimated stress, tons/in.²	Average increase in diam. after 7 days and 50 applications of 0–325 lb./in.². No internal pressure.	Estimated stress, tons/in.².	Average increase in diam. after 7 days and 50 applications of 0–325 lb./in.² under a pressure of 325 lb./in.².	Estimated stress, tons/in.².	Additional stress due to a pressure of 325 lb./in.².
B.E.S.A.	Run lead, hand caulked	31·57	0·0105	2·2	0·0078	1·7	0·0056	1·25	0·0095	2·05	0·8
B.E.S.A.	Run lead, machine caulked	31·57	0·0099	2·1	0·0066	1·5	0·0049	1·1	0·0087	1·9	0·8
B.E.S.A.	"Woolly" lead, hand caulked	31·57	0·0134	2·7$_5$	0·0116	2·45	0·0104	2·1$_5$	0·0143	2·9$_5$	0·8
B.E.S.A.	"Woolly" lead, machine caulked	31·57	0·0076	1·6$_5$	0·0068	1·5	0·0054	1·2	0·0095	2·0$_5$	0·8$_5$
Light type	Run lead, hand caulked	30·90	0·0152	3·1	0·0111	2·3$_5$	0·0077	1·7	0·0119	2·5	0·8
Light type	Run lead, machine caulked	30·90	0·0101	2·1$_5$	0·0074	1·6$_5$	0·0072	1·6	0·0112	2·4	0·8
Light type	"Woolly" lead, hand caulked	30·90	0·0239	4·5$_5$	0·0196	3·8$_5$	0·0193	3·8	0·0242	4·6	0·8
Light type	"Woolly" lead, machine caulked (2nd test)	30·90	0·0124	2·6	0·0107	2·3	0·0089	1·9	0·0131	2·7	0·8

The B.E.S.A. socket readings are those with the level. The light type socket readings are those with the depth gauge. The stresses given are those on the outer layer of the socket; the stresses on the inside of the socket would be slightly greater.

TABLE II.—*Permanent Increase in Diameter after Cutting Out Joint, in Inches (from Depth Gauge Readings).*

	B.E.S.A. socket.				Average permanent increase in inches (from socket in initial condition).
	Diam. A.	Diam. B.	Diam. C.	Diam. D.	
After cutting out, hand caulked—run lead	0·0003	—0·0004	0·0015	0·0009	0·0006
After cutting out, machine caulked—run lead	0·0032	—0·0005	—0·0004	0·0011	0·0008
After cutting out, hand caulked—"woolly" lead	0·0033	0·0013	0·0027	0·0017	0·0022
	Light type socket.				
After cutting out, hand caulked—run lead (preliminary test)	—0·0008	—0·0001	0·0009	—	0
After machine caulked—run lead	0·0033	0·0011	0·0055	—0·0049	0·0015
After hand caulked—"woolly" lead	0·0048	0·0048	0·0080	—0·0031	0·0036
After machine caulked—"woolly" lead (1st test)	0·0048	0·0093	0·0087	0·0035	0·0051
After hand caulked—run lead	0·0061	0·0128	0·0129	0·0041	0·0069

SIXTY YEARS AGO.

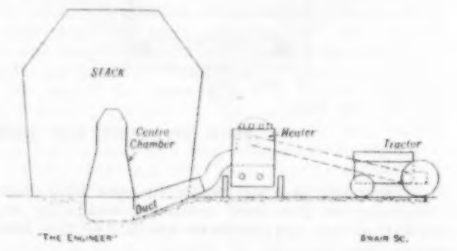
THE administration of the Patent Laws in this country sixty years ago had fallen into very bad ways. It was notorious that there was one patent law for the rich and another for the poor, and that the ingenuous inventor with no financial backing behind him was as a fly in a spider's web in the hands of an unscrupulous capitalist. So, at any rate, concluded Herr C. Schiele, as a result of his experiences among us. He was desirous of passing on the benefit of those experiences to others, and accordingly he wrote and published at Frankfort-on-Main a small work which we reviewed in our issue of September 28th, 1866. The title of his book was "Advice to his Brother Inventors in England. By C. Schiele. His Experiences with numerous patents for Fans, Turbines, the Anti-friction Curve, Wave Power, &c., &c., as well as Experiences of some other Inventors made useful for the General Good." Mr. Schiele and his inventions, particularly his fans and turbines, were well known to the engineering public of the day. He was a man of mark and had certainly been successful in inventing, however unsuccessful he may have been as an inventor. It is to be regretted that his advice to other inventors was couched in a Teutonic English style, which in places seems to have made his meaning a little doubtful. We say it is to be regretted because some of his advice would appear to be to-day still of value. Who, for instance, would not like to have a rule enabling him to determine whether his invention, as yet untried, will prove useful and profitable to himself? Mr. Schiele gave such a rule almost in the style of a mathematical formula. The inventor was told to "reckon the benefit you expect yourself of it at 10 per cent. of what others would gain by your invention in dealing with you, divide this again by ten, and if something like at least £500 remain, you may conclude that your invention is useful." If less than the sum named remained his advice was to publish the invention "by sending it with your name and address to the editor of a well read paper treating on such subjects" in order to get at least the credit for the idea. These rules applied only to inventors with at least £80 in their pockets to finance their inventions. If they had less than this sum Mr. Schiele advised them not to patent the invention, but to keep it secret, taking due precautions to establish evidence of prior user lest a subsequent patent should prevent him using his own invention. If the invention was of such a nature that it could not be kept secret, the inventor was advised to sell it to a manufacturer on the understanding that the manufacturer would patent it at his own expense and that the inventor would not be called upon to contribute towards the cost of defending the patent if it were challenged. The general lesson we drew from Mr. Schiele's advice was that most patenting was a sort of gambling as likely as not to turn out a blank or worse, and that to it could be applied *Punch's* famous advice on a similarly uncertain enterprise: "Don't."

The Artificial Drying of Crops.

WE have received from the Delegates of the Clarendon Press "the Preliminary Report of an Investigation into the Artificial Drying of Crops in the Stack," which has been carried out under the auspices of the Institute of Agricultural Engineering, University of Oxford. The contents of this useful publication, which is issued at the modest price of two and sixpence, chiefly comprise two parts, which are devoted respectively to field experiments in 1923, 1924, and 1925, and to laboratory work. The experiments carried out near Oxford in 1924 were witnessed by our representative, who reported favourably upon them in THE ENGINEER at the time. The publication under review contains a description and illustrations of the drying plant which was employed, together with some useful data concerning the time required to dry the crops and the cost of the drying process.

The drying plant employed is shown diagrammatically in the accompanying sketch. It comprises a portable engine or tractor fitted with a belt pulley for driving the fan, an air heater, a flexible duct, and a metal duct for the passage of the heated air, and a central chamber round which the stack to be dried is built. The heating unit is divided into three chambers, fitted with S-shaped tubes and baffles, through which the air is passed. The lower lengths of these tubes are lined with refractory materials, and the necessary heat is supplied by oil burners.

The heated air is propelled by way of the ducts into the central chamber in the stack. This chamber is made of iron or wood battens, and is covered with wire netting to prevent the crop falling through. The special feature of this chamber is the design which makes allowances for consolidation of the crop, porosity and turbulence, so that the heated air can circulate evenly through the stack. It has been found by experiments that the temperature of the heated air in the canvas duct should be about 180 deg. —190 deg. Fah., except for crops grown for seed purposes



PLANT FOR DRYING HAY

in which case the temperature should not exceed 140 deg. to 150 deg. Fah.

As regards the cost of artificial drying, an experiment carried out on a stack of meadow hay at Embley Park, Romsey, last July is quoted. The grass was cut and left in the swaths for one day. Stacking was completed and blowing commenced at 2.30 p.m. and continued till 10.30 p.m., when the stack was thoroughly dry, except for a portion at the bottom for about 2ft. up and 1½ft. circumferentially, which was slightly damp. The initial weight of the stack was 10½ tons, and the finished weight 7½ tons.

The fuel oil consumption was 64 gallons; average duct temperature, 183·8 deg. Fah.; average rise of temperature, 114 deg. Fah.; average volume of air, 10,000 cubic feet per minute; the highest delivery pressure was 2in. static and 2·8in. total. The running costs are given as follows:—Fuel oil, 64 gallons at 4½d., £1 4s.; tractor, eight hours at 1s., 8s.; total, £1 12s.

The cost of drying per ton of finished hay, according to these figures, is 4s. 3½d.; but it is not clear that the 8s. is sufficient to cover the cost of labour, interest on capital outlay, and depreciation of plant. Even so the cost of drying would probably compare favourably with the natural process, which entails a large amount of labour for turning, &c. It must be admitted that hay "made" naturally loses much of its feeding value. Rain or heavy dew wash away some of the soluble food constituents. On the other hand, with the artificial method, very few of the solid constituents are lost, while soluble carbo-hydrates show a distinct improvement. Similarly with regard to the drying of seeds. Tests made with barley and oats show that no damage is done to their germinating qualities by artificial drying, so long as overheating does not occur, *i.e.*, the temperature should not exceed 150 deg. Fah.

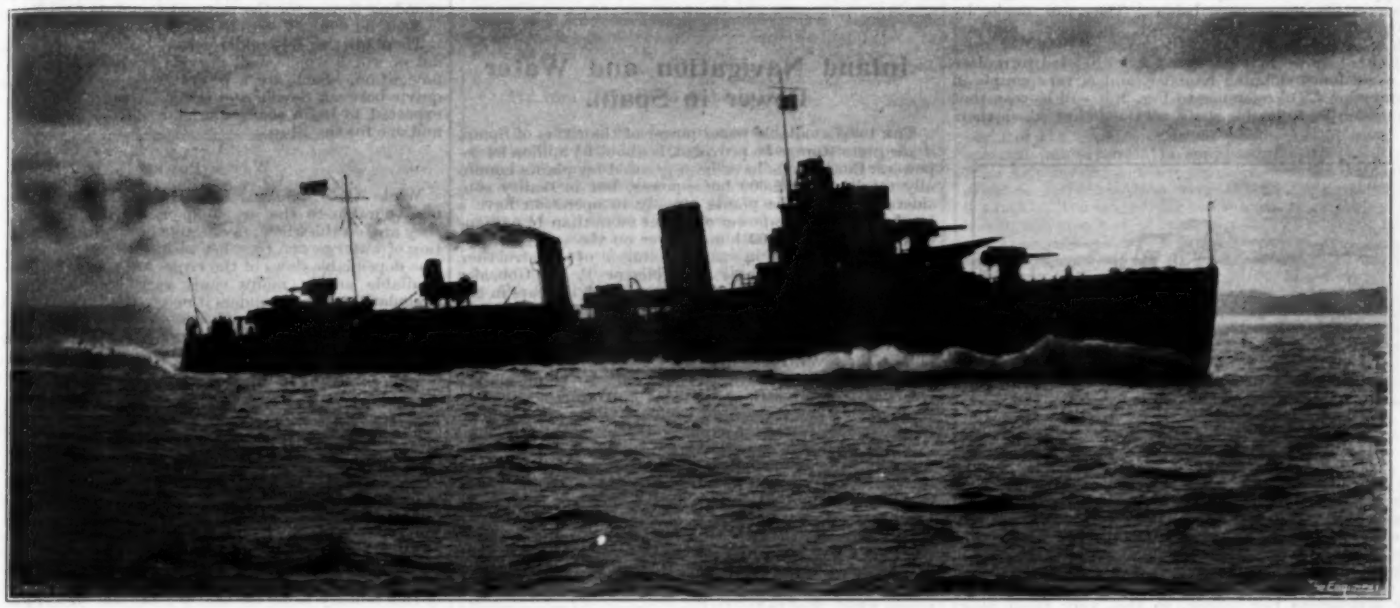
The report also contains much valuable information with regard to the artificial drying of other kinds of farm products, such as sugar beet, and it would appear that with the plant now available the difficulties met with only a few years ago have now been largely surmounted.

DALMARNOCK POWER STATION EXTENSIONS.

YESTERDAY, September 30th, the official opening took place of the new extensions at the Dalmarnock Power Station of the Glasgow Corporation Electricity Department, which have been carried out according to the plans and specifications of Mr. R. B. Mitchell, the engineer and manager of the Electricity Department. In the turbine house chief interest attaches to the two new single-cylinder Parsons standard reaction type turbines, each of which is built for a maximum output of 21,000 kilowatts. The turbines are designed to run at a normal speed of 1500 revolutions per minute, this being the maximum speed permitted by the 25-cycle direct-coupled alternators. The complete sets were supplied by C. A. Parsons and Co., Ltd., of Heaton Works, Newcastle. The turbines are supplied with steam at a gauge pressure of 270 lb. per square inch, with a total temperature of 700 deg. Fah., and they exhaust into surface condensers, which were designed and built by the Mirrlees Watson Company, Ltd., of

H.M. DESTROYER AMBUSCADE

YARROW AND CO., LTD., SCOTSTOUN, BUILDERS



Glasgow, and are complete with air pumps of the Mirrlees steam ejector type. The alternators are of the Parsons standard pattern, and they are cooled on the closed system by external motor-driven fans. Current is supplied by the alternators to step-up transformers of the Metropolitan-Vickers type, and the step-up bank, comprising three single-phase units, each with a capacity of 7800 kilovolt-amperes, the voltage ratio being 6500 to 20,000.

The new boiler-room, which is the third to be built, is equipped with eight Babcock and Wilcox marine type boilers, the normal full load output of each boiler unit being 50,000 lb. of steam per hour. Two mechanical stokers are fitted to each unit, four boilers being equipped with Babcock and Wilcox compartment type stokers, while the other four boilers have stokers by the Underfeed Stoker Company, Ltd.

As in the first and second boiler-rooms, cast iron economisers, built by E. Green and Sons, Ltd., Wakefield, have been installed in the new boiler-house, but in order to increase the overall boiler-room efficiency, the capacity of the economisers has been largely increased. The boilers are fed by turbine-driven pumps of the Weir type, and the powerful motors for the various boiler-room auxiliaries were supplied by the British Thomson-Houston Company, Ltd. The Metropolitan-Vickers Company, Ltd., provided the motors required in the turbine house.

The extensions to the coal-handling plant for supplying the new boiler-room, were carried out by Strachan and Henshaw, Ltd., of Bristol, and the newly installed coal plant includes a rotary tipper capable of dealing with 30-ton wagons, a steep hoist and a coal distributor. The additional auxiliary power required for the station was provided by a 1500 kilovolt-ampère 20,000 to 440-volt step-down transformer, which was supplied by Ferranti, Ltd.

H.M. Destroyer Ambuscade.

Of the two destroyers authorised under the Navy Estimates for 1924–25, H.M.S. Ambuscade is the first to be completed. She was laid down by Yarrow and Co., at Scotstoun, on December 8th, 1924, launched on January 14th last, and began her trials in July. The second vessel, H.M.S. Amazon, built by Thornycroft and Co., at Woolston, Southampton, is now undergoing trials. Apart from certain essential features, the design of these boats was left in the hands of the builders, with the result that they differ in dimensions. The Ambuscade has a normal displacement of 1210 tons, that of the sister boat being 1330 tons. Geared turbines with oil-fired boilers were specified in each case, and the contract called for a maximum speed of 37 knots, which is 1 knot higher than the designed speed of any previous British destroyer, though the flotilla leaders of the "Admiralty" and "Thornycroft" type were engined for 36·5. The plans of the Ambuscade were, of course, influenced by war experience, and therefore embody certain departures from former practice which we are not yet at liberty to mention. It may be said, however, that the new boats are more seaworthy, and have a considerably wider radius of action than their predecessors. Otherwise they bear a close resemblance to the "Admiralty Modified W" class, which are by common consent the most powerful and efficient destroyers afloat. The Ambuscade is armed with four 4·7in. guns, mounted on the centre line in the usual manner; seven 2-pdr. and machine guns, and two triple torpedo tubes. Special attention has been paid to the berthing accommodation for officers and men, in view of the possibility of service in the Tropics. Having regard to the very high speed for which they are designed, and to reports that this speed has been exceeded by a generous margin in the course of the Ambuscade's trials, it is to be hoped that the Admiralty will release some particulars of the steaming performances of the new destroyers. Twenty-seven further boats are to be built under the current programme, but for reasons of economy the first batch of nine is not to be laid down till next year. Owing to the wholesale deletion of boats built before and during the war, the destroyer establishment has now been reduced to about 135 units, a number which naval authorities consider inadequate for the requirements of the Fleet. The deficiency which has occurred in this highly important class of vessel is due, apart from the drastic scrapping policy adopted after the war, to the fact that nearly six and a-half years elapsed between the laying down of the last destroyer authorised under the war programme and the commencement of H.M.S. Ambuscade, the first of the post-war boats. A great deal of leeway has therefore to be made up, and it is exceedingly doubtful whether the twenty-seven boats to be built from 1927 to 1929 are sufficient for our minimum needs. Our illustration shows the vessel on her full speed trials.

South African Engineering Notes.

An Electric Drill.

Following on an article "Magnetically-operated Stamps," by Professor W. Holman, which was published in 1925, a paper was recently read by Mr. J. Burnard Bullock, before the South African Institute of Electrical Engineers, on "Some Applications of Variable Frequency Currents," in which the possibility of a satisfactory reciprocating electric rock-drill was adumbrated. In discussing this paper at the last general meeting of the Institute, Professor Holman was able to announce that Mr. Henry S. Potter had collaborated with Dr. Japolsky, inventor of the variable frequency system, and its associated apparatus, in the design of a rock-drill suitable for local conditions. Financial support for manufacture is apparently forthcoming, and it is probable that more will be heard, in the comparatively near future, of a practicable electric drill, a piece of apparatus which in the opinion of many electrical engineers, had been proved an impossibility.

Dock Improvements.

What is known as the Modified Southern scheme for improving shipping facilities in the Table Bay Docks, which involves the construction of a new basin to the south of the existing South Arm, and which will provide sufficient depth of water and lengths of berths to accommodate the largest liners likely ever to call at Cape Town, has been commenced. The total cost is estimated at £2,502,373 but only a small portion of this amount will be spent this year. In the meantime, however, the work of widening the South Arm itself and reclaiming ground on the shore side of the Dock road, is proceeding apace, while the work of extending the breakwater by a length of 1500ft., to provide the necessary protection to the new basin from heavy seas, is being pushed forward as quickly as circumstances will permit. Progress in clearing the bed for the undersea foundation has been delayed by the prevalence during the summer months of unusually heavy "ranges," which have been sufficiently powerful to carry heavy rocks and concrete blocks from the exposed face of the breakwater to the rear, and so to foul the bed as soon as it had been cleared. About 800 concrete blocks have been made and are ready for placing in position, so that when once these initial difficulties are overcome, it is anticipated that the work will proceed rapidly.

Newcastle Pig Iron.

Some thousands of tons of pig iron have now been produced by the Newcastle—Natal—blast-furnace, and the material is giving satisfaction, according to engineering works at Johannesburg, which execute large orders for the mining industry. Messrs. Wright, Boag and Co., whose engineering shops and foundries cover over three acres of ground, state that Newcastle pig is serving them splendidly, and they are getting it at £7 per ton landed at the works, which is slightly less than it costs to import. At the same time, English pig iron has been landed at £5 18s., and the Newcastle product costs £5 12s. at the works, and the railage to Johannesburg is 18s. per ton with a further 4s. 4d. for cartage and handling. Pig iron from India has been delivered at Johannesburg at £7. It is stated that the Railway Administration is considering the granting of a special rail rate. The Newcastle output, of course, benefits by the Government bounty of 15s. per ton. Very high praise is given by Steel Ceilings and Aluminium Works, Ltd., who state:—"Newcastle pig iron is the best material obtainable for our purposes, for which we require a very thin casting. We have tried Belgian, British and German pig iron, but the Newcastle product is superior to them all—at any rate, for our use; it is much softer and easier to machine, and runs in the mould more freely, and gives a beautiful thin casting—we have worked it at $^1/_{16}$in. in thickness."

Jack-hammer Drills.

In the past few years the jack-hammer drill has been introduced into every mine on the Rand, and has done wonders in increasing efficiency and reducing working costs. More important still, it enables a substantial reduction in the number of natives who would be required to do the same work by the old hand methods. There are now between three and four thousand at work on the Rand mines, and every chairman of a mining company, or manager, has been testifying during the last couple of years to the successive reductions which have been possible in working costs by their introduction and the improvements effected in them from time to time. The difference between the jack-hammer drill and the big machine drills, still used where there is plenty of room, is that it is a light and handy implement driven by compressed air, which can be used in almost any hole or corner a man can reach and at almost any angle. It is not surprising therefore, to hear that the use of a large number of these small drills has already had very beneficial results on the Taquah and Abosso Mine in West Africa. At the annual meeting of the company it was stated that ore can be broken by these machines 2s. 9d. per ton cheaper than by hand. British manufacturers should see that American makers do not get first into this market.

World's Cheapest Copper.

When the new treatment plants are in operation, and the shorter West Coast route is open, the Union Miniere du Haut Katanga Company's Copper Mine will produce the cheapest copper in the world. Meanwhile, the company is adding yearly to its ore reserves, which now stand at nearly 77,000,000 tons, while their average value has increased to 6.87 per cent. of copper, a remarkably high rate, and giving a total value, for the copper contained, of about £317,400,000. What with these extraordinary deposits in the Congo, and the important discoveries of recent years on the other side of the border in Northern Rhodesia—Bwana M'Kubwa Mine, for instance—Central Africa looks more than ever like becoming in the not very distant future, one of the greatest, if not the greatest, of the world's copper fields.

THE INSTITUTION OF FUEL TECHNOLOGY.

The autumn programme of the Institution of Fuel Technology will extend over two days—Tuesday and Wednesday, December 7th and 8th. On the first day Sir Alfred Mond will deliver his presidential address, and an inaugural dinner will be held in the evening. The list of authors and papers is as follows:—

Professor W. Groume Grjimailo, the University of Moscow, "Laws of Gas Flow in Furnaces."

Sir Richard Redmayne, K.C.B., "The Occurrence, Working, and Treatment of Brown Coal, with Special Reference to German Practice."

Mr. S. McEwen, "Low-temperature Distillation of Coal."

Sir John Biles, K.C.I.E., "Steam Power Production."

Professor J. Tausz, the University of Karlsruhe, "The Hydrogenation of Liquid Fuel."

Professor R. T. Haslam, the University of Massachusetts, U.S.A., "The Combustion of Carbon."

Mr. T. Hardie, chief engineer, the Gas Light and Coke Company, Ltd., "Practice in Gas Manufacture."

Dr. J. S. Owens, M.D., A.M. Inst. C.E., Superintendent, the Advisory Committee on Atmospheric Pollution, "Smoke and Public Health."

Two New Scaling Tools.

On the occasion of a recent visit to Birmingham we had an opportunity of seeing at work the two scaling tools shown in the engravings below. They are made by F. Gilman, Ltd., of Regent-street, Smethwick, and are both operated mechanically.

The tool shown in Figs. 1 and 2 is intended to replace the usual hand chipping hammer, and is very simple in construction. On reference to Fig. 2, it will be seen that it is driven by a flexible shaft, on the end of which there

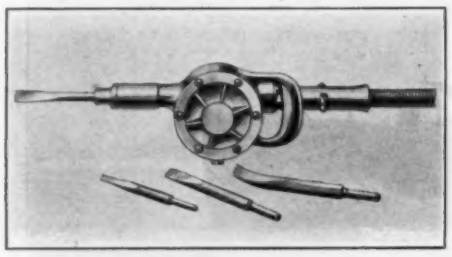


FIG. 1—SCALING TOOL

is a bevel pinion. This wheel meshes with another on a short shaft running transversely through the casing. Two arms on this shaft carry hardened steel rollers that are a free fit on their spindles. When the tool is running these rollers fly out under the action of centrifugal force and strike glancing blows on a striker which bears against the chisel. The flexible shaft runs at a speed of about 2800 revolutions per minute, so that very rapid blows are given to the chisel, and a powerful cutting action is produced. If it is desired to reduce the number of blows one of the rollers can, of course, be taken out and substituted by a fixed weight. The casing is of aluminium, so that the tool is quite light, and is easy to handle. When we saw it at work the chipper was being driven by a little 1½ horse-power petrol engine, and was removing great masses of scale, at least an inch in thickness, from the flues of an old Lancashire boiler. It was noticeable that very little dust was being produced by the action of the tool, and the speed at which it removed the scale was really astonishing.

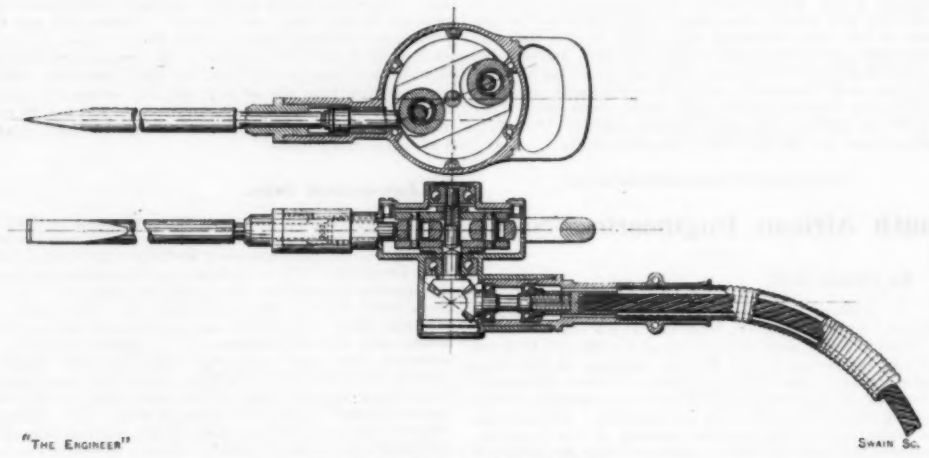


FIG. 2—SECTIONS OF SCALING TOOL

The apparatus shown in Fig. 3 has been specially designed for cleaning the interior of small tubes, such as

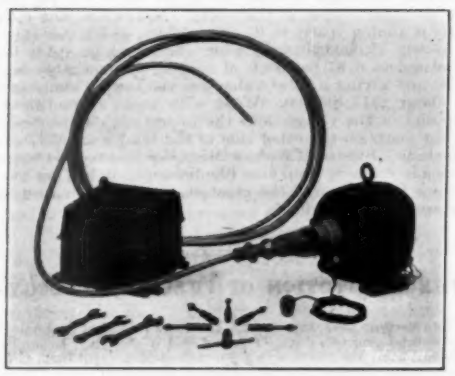


FIG. 3—TUBE SCALING TOOL

those of surface condensers, and is nothing more than a ½ horse-power high-speed electric motor directly connected with a length of flexible shafting. On the end of the shafting there is screwed a special form of cutting tool, five examples of which can be seen in the foreground of Fig. 3. The cutter has three wings, and is fixed in the socket by an easy-fitting transverse pin, so that the head is free to wobble slightly. In working on a condenser the motor is hung up from any convenient overhead support, so that it is approximately opposite the tube to be cleaned, and the tool is gently pushed through by means of the flexible shafting. At the same time a stream of water is sent through the tube from the opposite end of the condenser to wash out the chippings. This tool is not intended for clearing out tubes which have become very heavily scaled, but, so far as we can judge, is very effective in dealing with scale up to, say, $^1/_{32}$in. thick.

Inland Navigation and Water Power in Spain.

The total available water power of the rivers of Spain, if adequate storage be provided, is about 6½ million horse-power. Concessions have been granted for plants nominally totalling 4,375,000 horse-power, but in reality considerably less. The plants already in operation have a total nominal horse-power of rather more than 1½ millions and a further 790,000 horse-power on the same basis is covered by plants in various stages of construction. These are the estimates of Professor P. M. Gonzalez Quijano, who has prepared a paper, which appears in the *Revista de Obras Publicas*, descriptive of the conditions in Spain as regards inland navigation, or the lack of it, and summarising the data relating to the water powers available in the several river basins.

In both the north and the south of the peninsula the rivers are short, with steep beds and are torrential in character. They are subject to long periods of very small flow. In the eastern portion of the peninsula the conditions are similar as regards the rivers which have their sources in the mountain range of the Catalan Coast, and, in a less degree, those which rise on the Mediterranean side of the main Iberian mountain system. The Ebro is an exception. Its basin, 85,835 square kilometres in area, is the largest of those wholly in Spanish territory, and it has sources fed by the snows and rainfall of the Pyrenees. To some extent, nevertheless, it has the character of a torrential river. On the western side there are also short rivers, which flow to the Galician coast, and others wholly in Portugal, but the area is mainly occupied by the basins of the Miño, Duero and Tajo (Tagus), which rise in Spanish territory. The Guadiana and Guadalquivir, which have the same general direction of flow, may be regarded as intermediate in character between those western rivers and the rivers of the south, which are in the same climatic area. The former flows through Portugal, but the Guadalquivir is wholly within Spain. The gaugings on which the flows noted in Table I. are based were taken during the five years 1916–1920 at the following stations, all of which are in Spain:—Tortosa, Cantillana, Benavides, Alcántara, Toro, Puente de Filguiera. The "month minimum" is the average for the five years of the mean flow of the month of least flow in every year. The absolute minimum is usually about a quarter or a fifth of the "month minimum."

Table I.—*Spanish Rivers.*

Rivers.	Areas, square kilom.		Flows, cub. m.p.s.	
	In Spain.	In Portugal.	Mean.	Month minimum.
Ebro	85,835	—	693	218
Guadalquivir ..	56,528	—	163	19
Guadiana ..	66,490	11,364	110	6
Tajo	55,841	24,530	156	18
Duero	78,565	18,000	210	19
Miño	15,846	1,359	334	39

Subject as they are, in greater or less degree, to floods of great volume and velocity, as well as to long periods of very small flow, the rivers of Spain do not lend themselves to the development of inland navigation. Such natural waterways as they provide extend only short distances from the coast, except in so far as the deep inlets such as those of the north-west coast admit of navigation to relatively great distances inland. Seville, which is 103 kilom. from the sea by water and about 70 kilom. in a straight line, is the furthest inland of Spanish ports. Navigation of a kind is possible on the Ebro as far up as Zaragoza, which is about 180 kilom. in a straight line from the coast, but it is not such as can successfully compete with the railways.

Efforts have been made to establish inland communications by water on several of the Spanish rivers and by means of canals. The Canal Imperial and the Canal de Castilla* were made for navigation, but have been adapted to serve also for irrigation, which is now the more important of their functions. On the Canal Imperial navigation had been entirely suspended, but was reintroduced during the war. The amount of traffic has since steadily diminished as shown by the metric tonnage figures from 1918 to 1925 inclusive, as follows, in round thousands:—57,000, 47,000, 50,000, 25,000, 702 (?), 12,000, 29,000, 20,000. For the years 1921 to 1925 inclusive the corresponding figures for the restored Canal de Castilla were:—8000, 11,000, 11,000, 15,000, 17,000.

There are projects under consideration for the carrying out of works which shall provide for both irrigation and navigation. Such are a project relating to the Guadalquivir between Seville and Córdoba, work upon which is expected to begin soon, a similar scheme for the Tagus, and one for the Ebro.

Water Power.

While the conditions in the peninsula are generally unfavourable to the development of inland navigation, they are, on the whole, favourable in regard to the utilisation of water power, together with provision for irrigation. The dependable flows of the rivers are small, but the falls available are in many cases very considerable. The irregularity of flows renders it necessary to construct large storage works, the expenditure on which would involve high charges for electrical energy if the water could not be used also for irrigation. For this purpose its value is great, owing to the long dry seasons which are experienced in Spain.

Small dams with water wheels have been used in Spain from very early times, but their use was confined to purely local purposes until the invention of the dynamo extended their scope and led to the utilisation of greater falls. The following figures relate to gross theoretical horse-powers, as estimated by persons obtaining concessions. Up to 1890 the total power of plants of more than 100 horse-power apiece was nearly 111,000 horse-power. During the next decade nearly 180,000 horse-power was added in "concessions." Matters then progressed much more rapidly, the concessions of the first decade of this century being for nearly 1,143,000 horse-power, in the second decade 2,617,000, and in the next five years 685,000 horse-power, the total of all plants and concessions over 100 horse-power being nearly 5,000,000. These figures are considerably in excess of the powers really available, and Professor Quijano considers that in many cases the estimate should be halved. Up to the present the works begun or completed represent about half the total horse-power conceded, and those in operation about a third of that total. The figures, in round numbers, are given at the beginning of this abstract. The more readily available and the more conveniently situated falls having been already claimed, the rate at which the power available is being conceded is rapidly diminishing. There remain, however, important projects for the utilisation of some of the larger rivers. The falls of the Duero, on the Portuguese frontier, are estimated as capable of providing 300,000 horse-power, and it has been estimated that 500,000 horse-power can be utilised on the Tajo (Tagus). The latter figure is, Professor Quijano considers, unduly optimistic. All things considered, the total water power available in Spain is about 6,500,000 horse-power, distributed as shown in Table II., in which the figures are simplified to the nearest 1000 horse-power.

Table II.—*Water Power Available in Spain.*

	Horse-power.	
	Conceded.	Maximum available.
The Mediterranean slopes from the French frontier to the mouth of the Ebro	207,000	250,000
Basin of the Ebro	2,138,000	2,950,000
Slopes from the Ebro basin to the Júcar	128,000	150,000
Basin of the Júcar*	309,000	320,000
Slopes from the Júcar basin to the river Segura and basin of the Segura.. ..	102,000	120,000
Slopes from the Segura basin to the river Guadalquivir	141,000	190,000
Basin of the Guadalquivir	477,000	300,000
Basin of the Guadiana	16,000	75,000
Basin of the Tajo..	256,000	535,000
Basin of the Duero	158,000	470,000
Basin of the Miño and the north-west slopes	255,000	270,000
Cantabrian slopes..	638,000	650,000
Basin of the Garonna	210,000	220,000
Totals	4,735,000	6,500,000

WELDING COPPER TO STEEL.

During recent years much progress has been made in the direct welding of copper to steel, the principal application being the connection from rail to rail by copper cable for the conduction of electricity, and it is interesting to note that several of the leading American coal mines have adopted this system on their underground haulage lines, where electric locomotives are employed. The principle of this form of welding is that molten copper, from which the oxygen has been excluded, is maintained in contact with clean steel until the latter is raised to the melting point of copper, when a strong and ductile weld of copper to steel is obtained. An electric arc is used, and, in order to maintain the molten copper against the steel rail until the temperature of the latter is raised sufficiently high, it is customary to place each bond head in a mould against the side of the rail. In practice a special copper alloy is melted into this mould by an electric arc, and combined with the strands of the bond to form the finished head, while welding with the steel rail takes place at the same time.

The welding rod, which is a copper alloy, cleans the rail of oxide and scale, making grinding unnecessary, though heavy rust must be removed mechanically. This rod also eliminates the gases formed during welding. The rod is melted into the mould, and then maintained molten by

* The Engineer, October 2nd, 1925, and April 16th, 1926.

* The Engineer, March 26th, 1926.

the electric arc for about 35 sec., by which time the mould is full and the weld is effected. On test, about 32,000 lb. is required to shear a good weld thus effected, and the shear almost invariably takes place through the bond head, which yields before the actual weld between the copper and the steel rail. The contact area is usually about four to six times the cross section of the cable in the bond.

In other types of bond, lengths of annealed copper cable are factory-welded to steel terminals, these terminals then being welded to the rail.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Commodities Scarce—Prices Advancing.

INDUSTRIALISTS in the Midlands and Staffordshire are experiencing increased difficulty in securing adequate supplies of iron and steel. Production is on such a limited scale that, even with trade and the works disorganised by the many effects of the shortage of fuel, there is insufficient material to go round. As to the price of iron and steel generally, the tendency is for increased firmness, and the same observation applies to coal and coke, the selling value of which has sharply appreciated. What is more, continental supplies are becoming restricted and prices are firming up. Buyers in this country cannot satisfy their requirements on the hand-to-mouth plan; they must buy well in advance if they would make reasonably sure of supplies, and many of them hesitate to do this, hoping that ere long our own mills and forges will be able to satisfy their needs.

The Steel Situation.

In the steel department inquiries are numerous, and a great deal of work is waiting to be placed, especially for steel castings and for material wanted in connection with railway stock orders, but the tendency is to keep back contracts until the upshot of the coal negotiations can be determined. Steel plants which continue to operate are making a fair output, and consumers are very glad to get even the small tonnages available. The restarting of mills in South Wales and Middlesbrough has slightly relieved the situation for Birmingham users of steel. These mills were started to deal with pipe line orders, but a proportion of the output is available for open sale, and is proving very useful to constructional engineers, many of whom have, for some time been entirely dependent on foreign supplies, frequently unsuitable in size and quality. For plates ¼in. and up, the price charged is £10, with an additional £1 for basic boiler plates. A certain amount of re-rolling is still being done in the Birmingham area, but the offerings of finished steel are of relatively small tonnage. Small bars are quoted at about £8 10s. as a minimum. There continues to be a fairly good demand for structural material, but the prices to be paid are substantially in advance of the basic rates. Quotations are on the basis of £8 7s. 6d. to £8 12s. 6d. for sections, and heavy sections and joists from mills on the North-East Coast cost about £8 17s. 6d. by the time they reach consumers here. Strip fetches £8 10s. to £10 10s., according to specification. A considerable portion of the steel business given out finds its way to the Continent despite the fact that foreign material is much dearer than it was. The prices asked are such that, if British steel could be obtained, they would not be considered. Belgian and French billets are rarely offered, but German supplies are less restricted. For 3in. billets the high price of £6 has been quoted this week, and for 2in. £6 2s. 6d. to £6 5s., the foreign price thus approximating closely to English quotations before the strike. Continental sheet bars cost £6 5s. upwards.

Shortage of Structural Material.

One effect of the protracted nature of the coal strike is the shortage, now becoming apparent, in many classes of structural steel. Iron and steel works cannot be restarted on coal at £2 10s. a ton more, even if the coal available were of a quality suitable to their various requirements. Now that stocks of iron and steel and the various manufactured forms in which they reach the consumer are running low, the dislocations in dependent or partly dependent industries is being more severely felt. Building progress is being held up for lack of structural materials. Birmingham presents some surprising examples of new building and reconstruction of old premises pushed forward in the teeth of prevailing difficulties. There are, notwithstanding, notable enterprises which cannot proceed because fuel is unobtainable for the fabrication of the special material required.

Sheet Prices Advance.

The increasing scarcity of sheet bars and the high price which now has to be paid for them, whether the origin be Britain or the Continent, is causing anxiety to sheet rollers, who have plenty of orders. Many makers to-day asked a 5s. per ton advance on last week's prices. Those who had based quotations on £16 5s. advanced to £16 10s., and where £16 10s. had been the minimum £16 15s. was required. There has been an improvement in the home trade, for which £16 10s. was the lowest quotation. A contract has to be attractive to secure its acceptance at £16 10s. Orders come in plentifully, South African buyers are pressing for quick deliveries, and that is not without effect on the immediate outlook. Those mills that are running are booked up two to three months ahead as a rule. The rapid exhaustion of sheet bar supplies is stated to be likely to cause a stoppage at some mills. The £16 5s. quotation for export has not entirely disappeared, but few sellers are prepared to accept this figure.

Scrap.

Scrap is nearly unsaleable. Many steel works hold large stocks, and are not willing to buy unless at what are regarded as bargain prices. Values have recently declined from £2 17s. 6d. to £2 12s. 6d., but even at this figure steel smelters decline to place orders. Heavy accumulations are liable to serious deterioration, and the scrap business accordingly is stagnant.

Pig Iron Difficult to Obtain.

Pig iron has become scarce. It is difficult to get supplies from Middlesbrough, and the charges are so high that increasing use is made of French pig iron, now coming in, in larger quantities. A further cargo of this material has been sent specially for delivery in this district, and comes out at about £5 per ton delivered. The last consignment is stated to have been fairly satisfactory as regards quality. Nevertheless, although continental pig iron can be obtained at rates substantially lower than those quoted by the few British furnaces still producing, the demand for the native makes is much larger than the supply. True, consumers are not showing much interest in offers of iron for delivery after the resumption. Buyers are unresponsive to the increased quotation of £4 5s. for Derbyshire No. 3 at furnaces. Comparatively few Midland smelters think it worth while to reopen their order books till the situation clears. In any case, there will be considerable contracts which had not been completed when the stoppage took place, to fulfil, after the furnaces get to work again. Users of pig iron are much more concerned about immediate requirements. On 'Change in Birmingham to-day—Thursday—quotations for hematite could hardly be got. Small sales of East Coast hematite have been made this week round about £5 and £5 2s. 6d. West Coast hematite is quoted £5 7s. 6d. to £5 10s., delivered in the Midlands. Cleveland and Durham No. 3 foundry costs rather less than £5 10s. for delivery in the latter part of October. Rare consignments from Clydeside cost about the same amount with the heavier freight added, but foundrymen are glad to pay the price to get supplies. One peculiar effect of the strike has been to reverse the relation in prices between foundry and East Coast hematite iron. In normal times steel-making irons are invariably dearer than foundry brands, but the reverse is the case to-day. Smelters on the North-East Coast are reported to have sold their output over the next three or four weeks, and the position with regard to forward business is undetermined. The fuel position has not eased perceptibly except in respect of foundry coke, which is now coming in at cheaper rates from the Continent. A number of Midland trades are in difficulties through the inability to get gas coke from the Birmingham Corporation.

Finished Iron.

Production in the Staffordshire finished iron trade continues on an almost insignificant scale. Coal could now be had in sufficient quantity to restart ironworks, but there is no confidence in the quality, and the price is prohibitive. Manufacturers will not risk the serious deterioration of quality regarded as inevitable under present conditions. Very good orders are in hand or pending, assuring brisk operations when a beginning is possible. Belgian No. 3 bars continue to reach the district in large quantities for nut and bolt makers in the Darlaston district, who are fairly busy at the moment. From £6 5s. to £6 7s. 6d. is now required by shippers for new orders.

Manufacturers and Coal Distribution.

Midland manufacturers are greatly perturbed by the terms of the Mines Department's new order for coal distribution. They realise that under the priority scheme the amount of coal available for industrial purposes will be insignificant. They regard the new situation with grave misgivings, for they hold the view that in many cases it will be impossible to obtain supplies of imported coal in sufficient quantities to keep their works going, as on present lines, and that the amount of British fuel which will be available, after priority claims have been satisfied, will be relatively small. Many Birmingham and district industries will consequently feel the pinch much more acutely in the immediate future than they have hitherto done.

Midland Coalfields.

The number of miners at work in the Midland coalfields continues to grow, and throughout the district there is an increasing desire on the part of the workers to get back to the pits. Every day sees more men reporting for duty, and there are, at the time of writing, thousands more men getting coal than there were a week ago. The latest available figures show the number working in the Warwickshire area to be 13,324; Notts. and Derby, 39,064; South Derbyshire, 2162; and Cannock Chase, 12,335. There are now about half the usual number of men at work at the pits in the Cannock Chase area, including the Pelsall district. A considerable number of the newcomers are on the Hednesford side of the district. The decision of the Cannock Guardians to stop relief on loan is thought to have had considerable effect in hastening the return to the pits.

New Coal Measures.

After two years' strenuous work the Holly Bank Coal Company, has been successful in finding the deep and shallow seams of coal, of a thickness of 11ft. 8in., at its Hilton Main Colliery. The proving of these seams carries with it the proof of the presence of the other seams in the usual order. The company is to be congratulated upon having opened up a rich deposit of valuable mineral holding forth good prospects for the west side of the Cannock Chase coalfields, and promising employment, when the dispute in the industry is at an end, to a large number of miners in producing fuel on the threshold of the industrial area of Wolverhampton.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

A Railway Gathering.

IN spite of unfavourable weather which interfered seriously with the outdoor part of the programme arranged in connection with the railway employees' carnival held at Belle Vue, Manchester, last week-end, the event, attended by thousands of railway workers from all parts of the country, was an unqualified success. The carnival was arranged in conjunction with the Railway Film Association, and it is proposed to make it an annual event to be held in this city. Whilst the carnival spirit is probably the underlying motive of the gathering, there is also the object of promoting goodwill between railway managements and workmen, both being officially represented side by side. Sir Josiah Stamp, President of the London, Midland and Scottish Railway executive, who was present, referred to his recent visit to the United States and Canada in the course of an address to a large body of railway employees. His impression was that the railways in this country in every respect held their own against the American railway system. Personally, he said, he preferred the smartness of the English railway engine to the great size of the American engine. One of the impressions made upon him in the course of his trip was that, compared with the English driver, the American engine-driver did not know how to start or stop his engine. Mr. J. H. Thomas, who also addressed the gathering, said that the British railway system stood supreme from the point of view of efficiency and safety. A railway exhibition was an interesting feature of the carnival, the Rocket and the Cornwall standing alongside several of the most modern types, including an L.M.S. "Baltic" express, with sleeping and dining cars, and an L.N.E.R. exhibit, also of sleeping and dining cars. Models were contributed by various companies and by the Manchester College of Technology.

Training Engineers.

The task of finding accommodation for the growing number of students at the College of Technology, Manchester, is becoming a serious problem. An extension scheme has been prepared, and is awaiting final approval by the Board of Education, but until it is carried out the difficulty will grow. Mr. B. Mouat Jones, the Principal of the College, states that most of the graduates in municipal, sanitary and electrical engineering, and other branches of technical science, have found work in this country, and this has encouraged so many students to enter for graduate courses that the accommodation of the institution is being severely taxed, more particularly in respect of laboratory work. Mr. Mouat Jones adds that there seems to be a tendency at the present time for an increasing number of students to take a degree course in municipal and sanitary engineering.

A Textile Machinery Alliance.

Confirmation is now available of the reported agreement between the Manchester firm of textile machinists, John Hetherington and Sons, Ltd., and Kohorn, of Vienna and Chemnitz, who are specialists in the manufacture of machinery for the artificial silk industry. The Manchester firm, under this agreement, has secured the rights to manufacture under the Kohorn patents in this country and also the selling rights for several other countries. Difficulties arising from customs regulations and the heavy additional cost of plant as a result of railway and shipping charges on transport from the Continent are important factors that will be eliminated. An obvious advantage of the manufacture of artificial silk machinery in this country is that British users will have the benefit, should the need arise, of the nearby presence of trained men accustomed to dealing with such plant.

Tram Rail Famine.

The shortage of tram rails as a result of the coal stoppage is the cause of much concern to the Manchester city tramways department. For some time manufacturers of rails have been unable to quote for them, and the shortage has now become so acute that the Committee may have to suspend about 700 men through the hold-up of repair and constructional work. At a meeting of the Committee on Tuesday of this week, it was decided to recommend that manufacturers should be invited to quote for a supply of rails at enhanced prices to meet the increased cost of production arising through the coal stoppage. The Committee also decided to purchase twelve more motor omnibuses, nine of them double deckers with covered tops, and three single-deckers.

Non-ferrous Metals.

All sections of the non-ferrous metal market since last I wrote have had an easier tendency, but, with the exception of tin, which has displayed its usual fondness for the spectacular, the decline has not been serious. Tin, however, largely under the influence of bearish operations in America, lost a good deal of ground, and finished up much lower than a week earlier, notwithstanding an important recovery from the worst. The feeling seems to be, however, that the strength of the market is intrinsically sound, and no serious fall in values is expected unless there is a marked increase in available supplies of the metal. Copper, also, has given way compared with a week ago, the demand having been slow. A factor which has not been without its effect on prices has been the statement that the United States Copper Export Association, which has been hanging over the market for some months now but which was expected to start functioning at the beginning of this month (October), will not now begin its operations until the opening of the new year. Lead is lower on the week to some extent, perhaps in sympathy with the other metals, but largely because of the reduced domestic consumption, although stocks are said to be favourable to a continuation of steady prices. Spelter, at the moment, is about the steadiest section of the market, although here also quotations have declined a little.

Iron.

The feature of the iron market this week has been increased, prices now being asked for pig iron for prompt or early delivery. Scottish No. 3 foundry iron cannot be bought on this market now for less than 114s. 6d. per ton, including delivery into the Manchester district, and very little of this is available for immediate consumption, makers of this and other brands generally offering only for delivery towards the end of October. Middlesbrough No. 3 is quoted at about 112s. 6d. and East Coast foundry iron at 110s., with East Coast hematite on offer at 102s. 6d. per ton. These rates are roughly 2s. 6d. to 5s. per ton higher than they were a week ago. There are still no Derbyshire, Lincolnshire or Staffordshire makes of common iron on offer here, and there seems little disposition on the part of blast-furnace owners to quote now for delivery after the resumption of operations, although during the last few days prices ranging from 85s. to 87s. 6d. per ton at the furnaces for Derbyshire No. 3 iron have been mentioned in some markets. So far as the Manchester market is concerned, however, one cannot get makers to discuss forward business at the present time. There has been no change in the position of Lancashire bar iron. Supplies are exceedingly low, and prices are to a large extent nominal.

Steel.

From the point of view of actual business the steel market has been dull during the past week. There has been the usual steady call for continental steels, but delivery dates are becoming more and more remote, and offers of foreign materials, especially at the much higher prices that are now being asked, are becoming less attractive to users who are anxious to secure parcels within a reasonable time. This week a number of sellers of continental steels have declined to promise delivery earlier than December. An all-round advance has taken place, continental ship plates now being quoted here for delivery to Manchester works for cash against documents, at about £7 per ton, Siemens plates at £7 7s. 6d., joists at £6 7s. 6d., sections at £6 12s. 6d., sheet bars at £6 2s. 6d., billets at £5 15s., and steel bars at about £6 10s. per ton. There is not much change in the position of British steels, except that there is a firmer tendency regarding prices quoted by those firms which are willing to deal with forward contracts. A number of orders for ship plates have, however, been booked at about £8 5s. per ton delivered, and for basic steel bars at £8 15s. to £9, with joists and sections at anything from £7 12s. 6d. to £7 17s. 6d. per ton. Re-rolled bars for prompt delivery keep very firm at £9 10s. per ton, in sympathy with the dearer foreign billets and coal. The demand for galvanised sheets continues slow from the Indian market, although current values are firmer at £16 10s. to £17 per ton f.o.b., for the usual 24-gauge specifications. Prices quoted for thin sheets remain at their recent level, but there has been no improvement in the call for these sheets.

Scrap.

Inquiry for non-ferrous metal scrap is only moderate, but values are maintained at £39 per ton for brass rod turnings, £53 for gun-metal scrap, £57 for clean light copper, £52 for braziery copper, £31 for lead, and £25 10s. for zinc.

Barrow-in-Furness.

Hematite.

There is nothing to report about the hematite pig iron trade beyond the fact that makers are anxious for the coal dispute to be settled, so that they may commence the deliveries of considerable orders which they hold at present. If none of them were to receive another order, there is work for nearly twelve months, and it is safe to anticipate further contracts once the furnaces are in blast again. The same remark applies to the steel trade which, as soon as the mills get to work again, will be busy for some time to come. The hoop works are the only departments at Barrow which are engaged. The importation of coal into the port of Barrow continues to be heavy, and there have been some large cargoes from America. The demand continues to be very brisk. The heavy cost of coal is beginning to tell on some of the public undertakings, and it was stated this week that the Barrow Gas Committee had ascertained that the increased cost had already reached £14,500. This fact has compelled the Committee to recommend an increase of 6d. per 1000 cubic feet to consumers, which will be taken off as soon as things are normal again. Coke was increased to 40s. per ton to ordinary consumers, but the unemployed are to have it for 25s. per ton. There will be an important discussion at next Monday's meeting of the Barrow Town Council regarding the money spent without authority on the Backbarrow electricity scheme. The General Purposes Committee has passed a resolution regarding the action of an official, which will be submitted to the Council next week.

SHEFFIELD.

(From our own Correspondent.)

The Scarcity of Steel.

There is little or no progress to report in the production of steel for general uses. This industry, which is largely carried on in Sheffield and district, has been almost at a standstill for the last five months, owing to the impossibility of obtaining supplies of coal at a suitable price, and, although there were considerable stocks of steel when the miners' strike began, they are now almost exhausted. Some firms are so short of material required for their own manufactures that they have restarted furnaces, but they have done so at a heavy cost. The latest instance of this kind is afforded by Vickers, Ltd., who brought two open-hearth furnaces into commission again last week. Brown Bayley's Steel Works, Ltd., and Industrial Steels, Ltd., are also working two furnaces each, and there are one or two others in operation. But the total represents but a very small proportion of the district's productive capacity. All the great open-hearth plants at Rotherham and Templeborough are still idle with the exception of one at the Ickles works of Steel, Peech and Tozer, Ltd., and the big mills connected with these plants are in the same position. At Penistone, Cammell Laird and Co., Ltd., has six large capacity furnaces which are also idle.

A Good Outlook.

At present there is no demand for open-hearth steel in great tonnage quantities, which is perhaps fortunate, as such a demand could not be met. Not much in the way of steel material is wanted at the moment by the British railway companies. But there is a shortage of steel, nevertheless. At the rolling mills work is intermittent and mostly on small sizes, and the volume of it is falling, not so much for want of orders but because of lack of material. Indeed, orders of various kinds continue to come in, and considerable arrears have been piled up. Some firms in the heavy steel line have enough work booked to keep them going for several months—in certain cases as much as twelve months—while those which specialise in forgings and castings for the motor car and allied industries are equally well placed. The prospects of the steel trade, in the post-strike period, seem to be bright, provided that the price of coal does not rise unduly. Clayton Wagons, Ltd., of Lincoln, reports that the output of rolling stock has been maintained during the past year, and that the demand for forgings, mainly for the motor trade, has been such that it has been found necessary to make considerable extensions at the forge. The melting of crucible steel in Sheffield is at present on a comparatively small scale, and is extremely costly—so much so, that the material is sold at a considerable sacrifice. Quietness characterises all branches of the tool trade. These branches have been able to maintain a fair amount of activity, and retain their connections at home and abroad; but in the majority of cases they have had to submit to heavy losses in order to do so.

The Spanish Steel Decree.

The Sheffield Chamber of Commerce had no difficulty in obtaining the full support of the Associated Chambers, at their meeting at Hull last week, for its strong resolution of protest against the recent Spanish Royal Decree, which affects imports of steel so severely that it will practically kill Sheffield's trade with Spain. Mr. J. H. Chapman, the President of the Sheffield Chamber, in proposing the resolution, said the Decree was calculated to mean a loss of orders, to Sheffield manufacturers alone, of something like £200,000 per annum, whilst a still more serious feature was that the city's workmen would lose about £40,000 in wages. Sir Arthur Balfour stated that within three days of the signing of the Decree the whole of the trade of Sheffield was affected. Goods at ports were stopped, so were goods that were half manufactured and orders were cancelled. The resolution asked the Government to use its efforts to get the Decree withdrawn, and Mr. Chapman urged that a boycott of Spanish products by this country should be threatened. It was pointed out by delegates from Nottingham and Manchester that the Decree affected other places besides Sheffield, and the wording of the resolution was so altered as to declare that the Decree constituted a severe handicap "to all consumers in Spain of the affected commodities." The President undertook that the matter should be brought before the International Chamber of Commerce.

Effects of the Strike.

The Sheffield Electricity Department, like the Gas Company, has rendered valuable service to trade during the strike, by maintaining full supplies. Both undertakings were able to hold out for a long time without increasing their prices, but now both have had to succumb to the pressure caused by dearer coal. The Gas Company's increase was reported a week or two ago. The Electric Supply Committee of the City Council now recommends that, as from the September 29th meter readings, the charges for electricity on all units—including traction—charged at 2d. per unit or under shall be increased from 10 per cent. to 30 per cent. on basis rates, while for all units charged over 2d. the increase on the basis rate shall be raised from 5 to 15 per cent. There has been a further advance of 5s. per ton in the price of coke from the local gasworks. Large coke now costs 50s. per ton, compared with 25s. before the strike, while breeze coke is quoted at 51s. to 53s., as against 27s. to 31s. Another serious effect of the strike is to be seen in the decision of the Bentley Colliery Company to seal off part of its workings, owing to lack of men to deal with underground heating. It has closed ten stalls, which will throw out of employment anything up to 200 hands, and, unless there is a change of attitude on the part of the men towards safety work, further stalls, affecting 500 or 600 hands, may have to be closed. This action at Bentley follows a similar step which had to be taken at Bullcroft, also in the Doncaster area, a few weeks ago.

The Order for Army Safety Razors.

The recent decision of the Army authorities to supply recruits with safety razors in place of the old pattern instruments was received with equanimity in Sheffield, which, although it formerly enjoyed a large trade in the making of ordinary razors, recognises that the new style has gained the favour of the rising generation. Sheffield has adapted itself to meet the new needs, and it hoped that the Army order would be of advantage to it. But something like amazement has been caused throughout the city by the action of the Government in actually placing a large order for the new issue of razors with the Gillette firm. There are at least five firms in the city which do a big business in safety razor blades, while others make the holders. It does not appear that these firms were asked to quote. The matter has been raised in Parliament, where the Financial Secretary to the War Office stated that the Gillette Safety Razor, Ltd., with which the contract had been placed, was a British company, not controlled by Americans. He added that the company had undertaken to execute the contract entirely with British labour, to carry out the greater part of it at its factory at Slough, and the rest in Canada. It need hardly be said that, even after this explanation, Sheffield is not satisfied, and the matter will probably not be allowed to rest where it is at present.

Cutlery and Plate.

There is some improvement in the cutlery and plate trades, but not sufficient to put them in a satisfactory position. The seasonal trade has not developed as was hoped, for the amount of business coming in from overseas sources is not up to the average, while the home demand is suffering as a result of the coal dispute. While the aggregate amount of work on hand is in excess of anything previously known this year, it is not up to the normal for September, and only a few firms are favourably placed in respect of bookings. An increasing proportion of the goods called for is of low price, and profits are comparatively small. Lately, some good foreign orders for table plate have been executed. One of a valuable kind, given out by the Egyptian Government, was shared between a Sheffield firm and one in France. Sheffield is catering for the small tools and knives used in decorative leather-work, a craft which is of increasing popularity in the country.

Two New Bridges.

Road improvement and bridge reconstruction continues to make good progress. New bridges have been opened during the week in Derbyshire and Lincolnshire, and in both counties the authorities have been congratulated by the Ministry of Transport on their enterprise. The Derbyshire bridge is over the river Dove at Egginton, Burton-on-Trent. It has cost £42,000, of which the Ministry of Transport has contributed 65 per cent. It carries the Derby–Burton–Birmingham road, and with its approach, forms a by-pass to about 900 yards of the present road, superseding the dangerously narrow and hump-backed old "Monk's Bridge." It has a clear span of 123ft. on the skew and 120ft. on the square, and allows a carriageway 28ft. wide and two footpaths of 6ft. each. Sir Henry Maybury, Director-General of Roads, who opened the bridge, congratulated the county of Derby upon the vast improvement made lately in the surface of the roads, which, he said, was largely due to the zeal and capacity of the county surveyor, Mr. J. W. Horton. The Lincolnshire bridge referred to crosses the river Fortyfoot, on the main road from the Midlands to the Eastern counties two miles west of Donnington. It replaces an old hump-backed brick structure built in 1765, and is of reinforced concrete, 100ft. in length, with a carriageway 22ft. wide and two 3ft. footpaths, which can be converted into a carriageway when the need arises. The bridge has cost £5500, provided by a combination of authorities, and will be maintained by the Holland County Council. Colonel R. W. Butler, representing the Ministry of Transport at the opening ceremony, congratulated the authorities upon the improvements made to the highways, and said that nearly £1,000,000 had been spent by the Ministry in Lincolnshire within the past few years, which amounted to a total of £2,500,000 spent on road and bridge reconstruction.

NORTH OF ENGLAND.

(From our own Correspondent.)

Shipyard Labour.

In view of the severe depression which has prevailed in the shipbuilding industry during the past four years, and the urgent necessity that exists for using every possible means to bring about an improvement it was somewhat surprising that the report of the Joint Committee of employers and workmen suggesting ways to this end was only approved at the trade unions' conference by a small majority. Still the adoption of the report is welcome, and it is looked upon by North-East Coast builders as a very important step in the efforts which are being made to restore the prosperity of the industry. The acceptance of the principle of greater interchangeability of labour in the shipyards and of less rigid demarcation of work so far as the various crafts are concerned, should go a long way towards bringing about a reduction in productive costs, and so enable builders effectually to meet foreign competition. It is left to the employers and the individual unions to negotiate the practice, and no doubt difficulties will be encountered, but as there is a majority for the principle, it is surely not too much to hope that the bulk of the unions and the men concerned will lend their aid in bringing the decision into effect.

The Coal Trade Situation.

The fact that Northumberland coalowners have invited the Northumberland Miners' Association to a meeting to consider the coal position has imparted fresh interest to the situation in the Northern coalfield. The Executive Committee of the Association is to consider the communication, but a meeting is not likely to be held until the beginning of next week. It is understood that a new situation has arisen within the last week or so, and the time has come to make some kind of effort to get back the export trade on which the Northumberland coalfield mainly relies. Durham coalowners are equally desirous of getting into touch with the miners' leaders, and a move is expected in that direction any day. There does not appear to be any inclination at the moment among the Northumberland and Durham men to act independently of the National Federation, but a meeting between the owners and the miners might be helpful at this time, if only to try and get to closer grips with the economic issues which must be faced before anything like a permanent settlement can be arrived at, either in these districts or in the country as a whole. If district conferences are held in Northumberland and Durham, it is suggested that the following ideas might be a basis of discussion out of which a workable agreement might be evolved:—7½ hours per day for hewers; 8 hours for all other classes; and 10 per cent. reduction on the percentage on basis wages. This arrangement to continue until March 31st next, when monthly ascertainments of production and costs could be reintroduced, the surplus

profits, after meeting wages and all other costs, to be divided in the proportion of 87 per cent. to the miners and 13 per cent. to the owners. In such circumstances, the April proceeds and costs would regulate wages in June, and the May ascertainment July wages, and so on. The owners' original offer was a 10 per cent. reduction in wages conditional upon an eight hours' day. The 7½ hours' day for hewers is suggested as a possible compromise.

Cleveland Iron Trade.

Sales of Cleveland pig iron are very restricted, largely owing to the lack of supplies. Stocks are now completely exhausted, and the output of the two blast-furnaces still in operation is rapidly taken up. Since last week the Cleveland ironmasters have advanced prices by 5s. per ton, so that the quotation for No. 3 G.M.B. Cleveland pig iron is now 102s. 6d. per ton, compared with 70s. before the coal dispute. As a matter of fact, it is quite impossible to buy prompt iron from the makers, who are so heavily sold forward that for any orders now booked they cannot promise delivery before the end of October. Costs are steadily rising, and the demand for iron is so urgent that price has become a secondary consideration. Some of the big consumers are buying foreign iron, and can meet their needs at well below the local price. But there are many small scattered foundries which are completely dependent upon home sources of supply, and these are finding it very difficult to carry on. The position now is that makers are reluctant to quote at all, but 102s. 6d. per ton has actually been paid for No. 3, and 105s. for No. 1 foundry iron. Makers are not quoting for the lower grades, but No. 4 foundry can be put approximately at 101s. 6d., and No. 4 forge at 101s. per ton, all these prices being for home delivery.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade shows little change, although there are widely differing ideas as to values. The makers are quoting up to 87s. 6d. per ton at the works for mixed numbers, but there is still a fair quantity in the hands of merchants, and this is being sold at 83s. 6d. per ton for mixed numbers and 84s. for No. 1 quality.

Ironmaking Materials.

A cargo of North African iron ore has been brought into the river Tees this week, this being the first foreign ore to reach the district since the beginning of August. No new business, however, is reported. Values are still based on 21s. 6d. per ton for best Rubio ore, c.i.f. Tees.

Manufactured Iron and Steel.

With the arrival of more adequate supplies of fuel the outputs at the steel works are daily increasing. One firm on Teesside is now turning out about 300 tons of plates per day, and another about a similar quantity of rails and sections. There is a big demand for all classes of material, and it is reported that 30s. to 40s. per ton on pre-strike prices is being paid. There is still a heavy import trade in foreign bars, &c., but prices abroad are rising and the foreign sheet bars are now little below the English in price. This keeps up the cost of corrugated sheets, which are quoted £17 per ton for early delivery, while black sheets have advanced, and are now £11 10s. to £11 15s. per ton.

The Coal Market.

Although the situation in the Northern coal trade is nominally unchanged, both owners and merchants are taking a favourable view of the prospects. They appear to be confident that some definite move will be made in the course of the next few days, and that the dispute will be brought to an end quickly. At the same time there is no disposition to operate at speculative values, as exporters, after sounding the overseas markets, find a fairly good prospect of trade at moderate prices, but at fancy figures the consumer holds off. Speculators offer best quality steam and gas coals at from 22s. to 25s. per ton for shipment during the first two months after a settlement. Buyers, however, consider 20s. to 21s. as the maximum prospective value, so that business is severely limited. Sales of small parcels are stated to have been effected at 21s. to 22s. for November–December delivery. Operators in the imported coal trade are now marking time, pending the outcome of the London negotiations, and, so far as new business is concerned, all parties are holding off, but the numerous cargoes already booked for October and November shipments, and the large number actually now on passage, will be easily cleared. The pressure for early supplies is keen and operators have no difficulty in securing the full recent advance c.i.f prices. Best quality American steam or gas coals realise up to 50s. per ton on the North-East Coast while some continental grades are obtainable at about 48s. per ton.

SCOTLAND.

(From our own Correspondent.)

Foreign Coal.

The market for foreign coal has been extremely firm throughout the past week. Demands for prompt deliveries have been numerous, and while considerable quantities have arrived at East of Scotland ports, the supplies available are hardly adequate, and prices are steadily advancing. It is said that in some instances cargoes are being sold on the high seas. Approximate prices are as follows:—Silesian screened, 67s. 6d. to 70s.; unscreened, 65s.; Westphalian, screened 67s. 6d., unscreened 65s.—all per ton f.o.t. Glasgow, Grangemouth, Bo'ness or Leith. American unscreened, 65s. f.o.t. Glasgow; Westphalian foundry coke, 48s. to 50s. per ton f.o.t. Grangemouth or Bo'ness. Scottish patent fuel, 50s. per ton f.o.b. at Glasgow, Grangemouth or Bo'ness, and 51s. per ton at Leith.

Scottish Coal.

Small numbers of miners are drifting back to the pits in the various districts, but only in the Lanarkshire district is there anything approaching any real activity. Over 7000 miners are at work in Lanarkshire. Merchants experience considerable difficulty in securing supplies, and in some instances prices appreciate almost daily. Scottish screened coal is approximately 65s. to 70s. per ton; triping, 55s. to 60s.; and dross, 45s. to 47s. 6d.—all in truck at pit. Household coal is from 3d. to 6d. per cwt. dearer, and sells on the average at 4s. 3d. to 4s. 6d. per cwt. bag, according to quality and district.

Steel and Iron.

With the future still uncertain owing to the situation in the coalfields, no improvement in the steel and iron trade can be reported. Steel re-rollers are maintaining a steady output, which meets with a ready sale. The output of bar iron is very modest, activities being mostly confined to steel. Black sheets have a steady demand, though inability to name deliveries is hampering business. Galvanised sheets also are busy. Consumers of heavy steel are forced to look elsewhere for supplies. All the local works are closed, and are not likely to reopen until home coal is available and at a moderate price. Prices of all available materials are on a firm level.

Pig Iron.

Stocks of pig iron are steadily diminishing, and the turnover is now confined to very small quantities, partly on account of low stocks, but also owing to the difference of opinion between buyers and sellers on the matter of price.

Dismantling Blast-furnaces.

The Scottish blast-furnaces have been put out of action for some time now, the high price of coal rendering production unprofitable. For some time back the trade has been going from bad to worse. Outputs have been dwindling, but never became any easier to dispose of. In normal times some eighty-five furnaces were in blast, but before the coal strike the number had fallen to twenty. The coming of the strike soon put these out of action, and now comes the announcement that the Dalmellington Iron Company, Ltd., has decided to dismantle its blast-furnace plant with a view to avoiding further expense.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

The fact that no progress was made last week by the Government in arriving at a basis on which negotiations could be opened with the coalowners, does not mean necessarily a prolongation in the stoppage of work in the coalfield. It is interpreted rather as opening a shorter cut towards ending the present struggle, if the Government withhold its intervention. The feeling prevails that so long as the miners' leaders think that there is anything to be got by Government action, so long will they refrain from coming to terms for an economic settlement. There is already evidence that, provided matters are left alone by the Government, the rank and file of the miners will enforce a quicker resumption of work. Even in South Wales, where the view has always been held that the settlement would come last, the miners are making a move. A notable case is that of the Ocean Coal Company's pits in the Treorchy district, where on Monday 200 out of 1000 men signed on for work at the Dare pit, while on Tuesday the movement spread to the Parc pit, where, under normal conditions, 1500 miners are engaged. Altogether, about 400 men have signed on, but work has not yet been started. The company has made arrangements to get the horses back to the pits, so that work can be resumed as soon as possible, while it is interesting to note that, despite the length of the stoppage, the pits are in such a good state that 60 per cent. of the men normally employed can be taken on almost immediately. Naturally, the Federation leaders have been and are doing their best to oppose this back-to-work movement, and there was a hurriedly called mass meeting of the men in that district on Tuesday, which was attended by the agent for the Rhondda No. 1 district, and also some of the men who had signed on for work. The result of the proceedings was that a compromise was arrived at, the men who had signed on for work agreeing not to put their decision into operation pending the outcome of the national delegate conference, held in London on Wednesday, while the agent undertook to present a report of the proceedings of that conference on Thursday, if possible, or not later than Friday. It is, however, understood that if that report does not offer any real hope of an early settlement of the dispute it will be futile for the Federation leaders to appeal to the men to refrain from taking matters into their own hands. It is not only at the Treorchy district that the miners are becoming restive. There is good authority for stating that in other areas colliery managements have been approached by men seeking to return to work, and the managers have informed the men what the minimum number of men is, for which the pits will be again opened for work. The terms on which the men at the Dare and Parc pits have signed on for are an eight-hour day and the wages which were ruling in April last.

Importation of Coals.

Last week the quantity of coals brought into South Wales ports was round about 70,000 tons, and there is a very considerable quantity on the way from America. It is understood that the Great Western Railway Company has twenty-two cargoes due, aggregating about 160,000 tons, apart from which, other importers have cargoes scheduled to arrive shortly from the Continent as well as from America. At the beginning of this week there were just over a dozen steamers discharging at local ports. The coals are urgently required, and the shortage of supplies is very pronounced. The colder weather is, of course, stimulating the demand. The Cardiff Coal Committee discussed the position on Monday, when it was stated that the Corporation was prepared to release 2000 tons for domestic purposes. The Committee decided to allow a retail price of 3s. 6d. per cwt. to be charged for coal purchased at collieries now working; the coal in stock, that available from the dump, and that purchased at a lower price, to be retailed at the figure now in operation, viz., 3s. per cwt. The position all round so far as coals are concerned for bunker purposes is a very difficult one, and prices have been soaring. As much as 60s. to 70s. per ton is quoted for supplies of coal at South Wales ports, and also at other bunkering ports in this country. The trouble is that supplies are practically unobtainable, while even at continental ports it is nothing for vessels to have to wait several days after completing the taking in of cargo in order to obtain supplies of bunker coals. At Hamburg bunker coals have commanded as much as 49s. per ton, and at Antwerp quotations have been round about 42s. 6d. to 45s. per ton.

Post-stoppage Coal Prices.

So far as is known, no business has been done in Welsh coals for shipment abroad after the troubles in the coal trade are ended. The reason is that no definite quotations are forthcoming for coals, and there is the further risk attaching to the freight. Exporters prefer for the time being to look on before making any offers abroad. At the same time it is reliably reported that a certain amount of business has been done in coals for delivery within four weeks of a settlement being arrived at, the coals being for home consumption. This business is on the basis of 30s. to 35s. per ton at the pithead for the best large coals, which means that the price to the consumer will be in the neighbourhood of 50s. per ton, and in the case of purchases on the hundredweight basis the price will work out nearer to 55s. per ton. The belief is entertained that the demand for coals for home consumption will be so great that even after a settlement is reached the authorities will keep a very tight hand on all coals produced, and that for a fortnight or so comparatively little coal will be available for export.

Traffic Returns.

The statistics issued by the Great Western Railway Company regarding the trade at the docks under its control in South Wales show that for the four weeks ended September 5th last, the aggregate of imports and exports was only 608,789 tons, as against 623,598 tons for the four weeks preceding. Taking the whole of this year to September 5th, the amount of imports and exports comes to 15,533,159 tons, which compares with 23,507,001 tons for the same period of 1925, the reduction in trade being about 8 million tons.

South Wales Institute of Engineers.

Mr. T. Allan Johnson, the managing director of the Hills Dry Dock and Engineering Company, Ltd., of Cardiff, has been elected by the Council as President of the South Wales Institute of Engineers for the session of 1927, and will assume office at the annual meeting of the Institute in January next. Mr. Johnson, who is a native of Newcastle, and came to South Wales in the early 'nineties, has been a member of the Institute for a quarter of a century, and for the greater part of that period has been a vice-president of the Institute.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Coalowners' Offer.

A meeting of the members of the South Wales Coalowners' Association, held at Cardiff on Wednesday, decided that the subsistence wage of 8s. 0¾d. for adults should be maintained for the month of October, and that the wages to be paid shall be 42.22 per cent. on the 1915 standard base rates. In all other respects the conditions for working shall be the same as contained in the offer of the Coalowners posted at the collieries on July 7th last.

Miners Drifting Back.

Later reports from the coalfield show that the miners are signing on for work in increasing numbers, and in a few instances work has actually been commenced, while there are definite indications that before the end of the week additional numbers of men will resume work without waiting for a settlement by their leaders. Among the latter are the miners who have signed on at the Dare and Parc pits belonging to the Ocean Coal Company.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

British Drying and Heating Company, Ltd., has removed to 14, Waterloo-place, London, S.W. 1. The telephone will be Gerrard 4850.

Mr. Philip Gee has removed from 40, King-street, Covent Garden, to 5, New-court, Lincoln's Inn, W.C. 2.

The Becco Engineering and Chemical Company, Ltd., has removed from 158-160, City-road, London, E.C., to Fitzalan House, Arundel-street, Strand, W.C. 2. Telephone, Central 8317; telegrams, "Engichemco, Estrand, London."

Robert Jenkins and Co., Ltd., Rotherham, ask us to say that their London office at 15, Victoria-street, Westminster, has been closed, and that their interests in London and the South will continue to be represented by Mr. C. Jenkins, of "Ivanhoe," Swanley, Kent.

Mr. A. W. B. Wilson has resigned his position with Fuller's United Electric Works, Ltd., of Chadwell Heath, London, with whom for many years he was the London sales manager, to take up an appointment as sales manager to the London Battery and Cable Company, Ltd., of Hesketh-road, Forest Gate, London, E. 7.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 2 6	—
No. 1 Foundry	4 15 0	—
No. 3 Foundry	4 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 3 0	4 3 0
No. 1	4 3 6	4 3 6
Cleveland—		
No. 1	5 5 0	5 5 6
Silicious Iron	5 5 0	5 5 6
No. 3 G.M.B.	5 2 6	5 3 0
No. 4 Foundry	5 1 6	5 2 0
No. 4 Forge	5 1 0	5 1 6
Mottled	5 0 0	5 0 6
White	5 0 0	5 0 6
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
„ „ Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 5 0 to 3 10 0	
„ Forge	2 16 0 to 2 17 0	
(3) Derbyshire—	(*None offered.*)	
No. 3 Foundry	3 7 6 to 3 15 0	
Forge	3 2 0 to 3 5 0	
(3) Lincolnshire—	(*None offered.*)	
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 11 0 (*a*) / 4 14 0 (*b*) / 4 17 6 (*c*)	— / — / —

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	11 10 0 to £12	11 0 0
Best	—	—
N.E. Coast—		
Common Bars	11 5 0	—
Lancs.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	—
S. Yorks.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
Midlands—	(*Prices nominal.*)	
Crown Bars	11 5 0 to 11 10 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 10 10 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up	7 17 6	7 0 0
Sections	7 7 6	6 5 0
Steel Sheets, under 3/16in. to ½in.	11 5 0 to 12 5 0	
Sheets (Gal. Cor. 24 B.G.)	— £17 5 0 to 18 5 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 0 0	—
Angles	7 10 0	—
Boiler Plates	11 10 0	—
Joists	7 10 0	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 0 0†	—
Light Rails	8 5 0 to 8 10 0	
Billets	8 0 0 to 11 10 0†	
Manchester—		
Bars (Round)	9 10 0	—
„ (Small Round)	10 0 0	—
Hoops (Baling)	11 0 0	11 0 0
„ (Soft Steel)	10 15 0	10 15 0
Plates	8 5 0	—
„ (Lancs. Boiler)	11 10 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	11 0 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	7 5 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
Midlands—		
Small Rolled Bars	7 15 0 to 8 10 0	
Billets and Sheet Bars	6 2 6 to 6 7 6	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 10 0 to 16 15 0	
Angles	8 7 6 to 8 17 6	
Joists	8 7 6 to 8 17 6	
Tees	9 7 6 to 10 17 6	
Bridge and Tank Plates	7 17 6 to 8 15 0	
Boiler Plates	11 0 0 to 11 15 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	20/3 to 23/-
Block Tin (cash)	313 10 0
„ (three months)	302 15 0
Copper (cash)	58 7 6
„ (three months)	59 2 6
Spanish Lead (cash)	31 15 0
„ (three months)	31 11 3
Spelter (cash)	34 15 0
„ (three months)	34 11 3
Manchester—	
Copper, Best Selected Ingots	65 12 6
„ Electrolytic	66 15 0
„ Strong Sheets	90 0 0
„ Tubes (Basis Price)	0 1 1
Brass Tubes (Basis Price)	0 1 0
„ Condenser	0 1 2½
Lead, English	33 10 0
„ Foreign	31 17 6
Spelter	34 12 6

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 to 1/11 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 0 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 0 0	7/3
„ „ 8 p.c. to 10 p.c. „	£20 15 0	6/6
„ „ Specially Refined		
„ Max. 2 p.c. carbon	£37 0 0	12/6
„ „ „ 1 p.c. „	£43 10 0	15/-
„ „ „ 0·70 p.c. carbon	£54 10 0	17/6
„ „ „ carbon free	1/5d. per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£15 for home.	
„ Silicon, 45 p.c. to 50 p.c.	£10 0 0 unit	£15 for export 0 scale 5/- per
„ „ 75 p.c.	£17 0 0 unit	0 scale 6/- per
„ Vanadium	14/9 per lb.	
„ Molybdenum	5/3 per lb.	
„ Titanium (carbon free)	0/11 per lb.	
Nickel (per ton)	£170	
Cobalt	10/- per lb.	
Aluminium (per ton)	£112	

FUELS.

SCOTLAND.

	(*Prices nominal.*)	Export.
Lanarkshire—		
(f.o.b. Glasgow)—Steam		15/9
„ „ Ell		16/6
„ „ Splint		16/6 to 17/-
„ „ Trebles		15/9
„ „ Doubles		14/- to 14/6
„ „ Singles		13/9
Ayrshire—		
(f.o.b. Ports)—Steam		16/9
„ „ Jewel		17/- to 17/6
„ „ Trebles		17/-
Fifeshire—		
(f.o.b. Methil or Burntisland)—Steam		12/6 to 14/9
Screened Navigation		21/-
Trebles		14/- to 15/-
Doubles		14/-
Singles		13/- to 13/6
Lothians—		
(f.o.b. Leith)—Best Steam		14/- to 14/3
Secondary Steam		13/6
Trebles		14/6 to 14/9
Doubles		13/6
Singles		13/6

ENGLAND.

(8) N.W. Coast—		
Steams		*No quotation.*
Household		„
Coke		„
Northumberland—		
Best Steams		16/-
Second Steams		14/6 to 15/-
Steam Smalls		8/- to 8/6
Unscreened		13/- to 13/6
Household		20/- to 22/-
Durham—		
Best Gas		18/6 to 19/-
Second		15/- to 15/6
Household		20/- to 22/-
Foundry Coke		18/- to 20/-
Sheffield—	Inland. (*Nominal; none on offer.*)	
Best Hand-picked Branch	31/- to 34/-	—
Barnsley Best Silkstone	28/- to 30/-	—
Derbyshire Best Brights	26/- to 28/-	—
„ „ House	24/- to 25/-	—
„ „ Large Nuts	17/- to 20/-	—
„ „ Small	12/6 to 14/-	—
Yorkshire Hards	17/- to 19/6	—
Derbyshire Hards	16/- to 19/-	—
Rough Slacks	10/- to 12/6	—
Nutty Slacks	7/5 to 9/-	—
Smalls	3/6 to 6/-	—
Blast-furnace Coke (Inland)*	—	—
„ „ (Export) f.o.b.		16/- to 17/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals: (*All prices nominal.*)	
Best Smokeless Large	26/- to 27/-
Second „ „	24/6 to 25/6
Best Dry Large	24/- to 25/-
Ordinary Dry Large	21/- to 22/-
Best Black Vein Large	25/6 to 26/-
Western Valley Large	24/6 to 25/-
Best Eastern Valley Large	24/- to 25/-
Ordinary „ „	23/6 to 24/-
Best Steam Smalls	17/- to 18/-
Ordinary „	16/- to 17/-
Washed Nuts	19/- to 20/-
No. 3 Rhondda Large	26/6 to 27/-
„ „ Smalls	18/- to 18/6
No. 2 „ Large	24/- to 25/-
„ „ Through	20/- to 21/-
„ „ Smalls	15/- to 16/-
Foundry Coke (export)	40/- to 50/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	42/6 to 45/-
Pitwood (ex ship)	26/6 to 27/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	39/- to 40/-
Seconds	32/6 to 35/-
Red Vein	27/- to 29/-
Machine-made Cobbles	47/6 to 50/-
Nuts	47/6 to 50/-
Beans	42/6 to 44/-
Peas	23/- to 25/-
Breaker Duff	7/6 to 8/-
Rubbly Culm	12/6 to 13/6
Steam Coals:	
Large	22/6 to 24/6
Seconds	20/- to 22/-
Smalls	11/- to 15/-
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated.
coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations
according to analysis; open market 17/6 to 19/- at ovens. † Latest quotations available. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Public Works Economies.

In common with the other Government departments the Ministry of Public Works has presented a programme of economies which should help materially to improve national finances. The idea of the Ministry in simplifying the service and cutting down expenses is to concentrate effort upon works that must be carried out, and to leave in abeyance those undertakings which are of no immediate importance. In the Ponts et Chaussées it is intended to dispense with the services of ninety-three engineers, as well as those of eighty others occupying subsidiary positions. There is also to be a reduction in the staffs of other departments. The control of the railways is to be simplified, and it is intended to unify railway material as far as possible, in the same way as rails had to be unified when purchased in the United States during the war. Efforts are also to be made to solve immediately the problem of the Paris suburban traffic which, in the hands of the railway companies, is carried on at a heavy loss. Last year the deficit amounted to 240 million francs. It is recognised that the suburban traffic cannot be dealt with in the same way as the main line traffic, and must be specially organised, and negotiations are now being carried out with the town of Paris, the Department of the Seine and the local communes with a view to the formation of a company which will take over the suburban lines. So far the negotiations have not proceeded smoothly, principally on account of the opposition of the Paris municipality, which refuses to have any further burdens imposed upon it, and the main hope now seems to lie in the Department of the Seine, which already controls the tramway services. The State also intends to relieve itself of the cost of maintaining 530 maritime establishments around the coast, the vast majority of which are of purely local interest. In future it will only control ports having national importance, and the others will be handed over to local authorities, which will have the right to raise taxes for their maintenance. Upon railway improvements and construction the State has spent in less than six years 1200 million francs. It is declared that the conditions under which the money has been laid out have not always conduced to economy. It has therefore been decided to concentrate effort upon a few undertakings of national interest which are certain to give profitable results. All railway construction is accordingly to be stopped, except the completion of 481 kiloms. of international lines and 398 kiloms. of other lines, which are already well advanced. In other words, work will be continued on 879 kiloms. out of a total of 2408 kiloms. which have been sanctioned. Something, however, will have to be done in future with the 1910 kiloms. of railways which the companies are required to build in accordance with the convention of 1921, but the Minister of Public Works declares that nothing can be done beyond constructing lines that are really of national importance. The Government will adopt the same principle with regard to maritime works. Makers of railway and other material who depend upon the State for orders can therefore see little hope of an early improvement in their present precarious situation.

Railway Catastrophe.

One of the most extraordinary accidents recorded in recent years was the collision that took place last week at the Vulaines Station, on the line between Melun and Montereau. A curious thing about it is that it seemed impossible that such an accident could happen. While a train was passing through the station a coupling broke and three coaches had to be left, while the rest of the train proceeded on its journey. Being very early in the morning the passengers remained in the coaches until a locomotive should arrive to take them on their way. The weather was foggy and the block system was deranged. Meanwhile, the driver of the Vintimille express, which was coming up behind, was notified of the state of things at Vulaines, and was instructed not to exceed the regulation speed, under such circumstances, of 12 miles an hour. According to the driver's statement, on nearing Vulaines he found the line signalled as open, and thinking that the stranded coaches had cleared he accelerated to 37 miles, at which speed the locomotive crashed into the coaches and reduced them to splinters. The locomotive itself was practically demolished. Six passengers lost their lives and about thirty were seriously injured. The driver was pinned under the locomotive with his legs in scalding steam. The responsibility of the driver or the signalman has yet to be determined.

New Wireless Invention.

The drawback to wireless telegraphy is its want of secrecy. At the Croix d'Hins Station, near Bordeaux, experiments have been carried out for some time past with a view to adapting the Baudot printing system, but this was found impracticable on account of atmospheric disturbances and interferences. The experts at Croix d'Hins therefore set themselves the task of eliminating this trouble, and they now claim that they are communicating freely with Madagascar with messages printed on arrival. This result appears to have been achieved by a modification of the Baudot apparatus. A semi-official communication issued last week implied that wireless telegraphy was operating with the same secrecy and rapidity as the cable and that consequently the cable was doomed to disappear.

Belgian Import Duties.

The belief that the economic situation of those countries which are endeavouring to stabilise their currency can only be saved by restricting as much as possible the purchase of foreign goods is steadily gaining ground, and now Belgium has put up its import duties a further 30 per cent. chiefly upon metals and engineering products. This step has been taken, it is stated, in order to protect home industries and to provide additional revenue. The raising of fiscal barriers to a point at which business becomes impossible, does little to improve the situation of the countries directly concerned, and must hasten the time when some international arrangement will have to be come to for a return to normal conditions.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

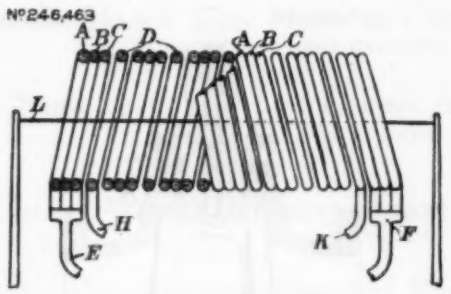
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TELEGRAPHS AND TELEPHONES.

246,463. January 13th, 1926.—Improvements in or relating to Discharge Tubes Comprising an Incandescent Cathode and Two or More Further Electrodes Lying in the same Cylindrical Surface, N. V. Philips, Gloeilampenfabrieken, of Emmasingel No. 6, Eindhoven, Netherlands.

The grid of the valve shown in the accompanying illustration has been helically wound with three wires A, B, and C, lying close to and against each other. An anode wire D has been helically wound in the same cylindrical surface between the grid windings and slightly spaced apart therefrom. At their

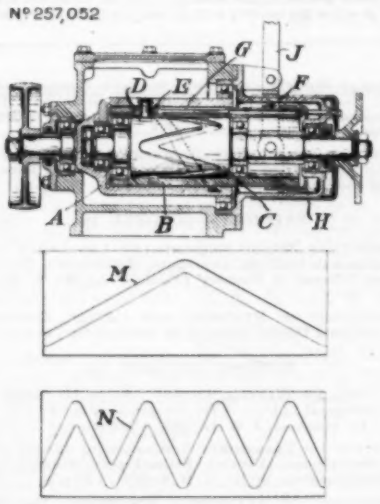


ends the grid wires are fixed in carriers E and F, which are sealed in the pinch of the stem of the valve and either of which may be used to conduct the grid current. The anode wire D is supported by carriers H and K. An incandescent cathode L passes axially through the tube formed by the wires and is supported as shown. The whole is sealed in any known manner in a bulb which is exhausted. In order to secure an even control of the space current it is advisable to make the pitch of the screw thread not larger than the radius of the cylinder. The precise method of constructing valves in accordance with the invention is described.—*August 19th*, 1926.

TRANSMISSION OF POWER.

257,052. June 27th, 1925.—Improvements in Variable-speed Mechanism, Septimus Edwin Scott, of 6, Newcourt, Lincoln's Inn, London, W.C.

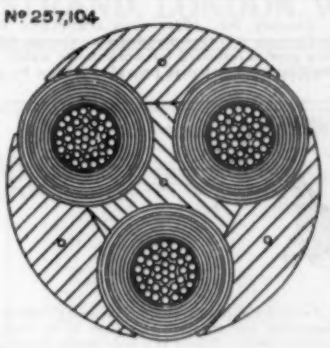
This invention relates to variable-speed mechanism, and comprises essentially an arrangement of three rotating members A, B and C, one within the other, which may be accommodated in a gear-box and run in ball bearings as illustrated. The outer member A, which is formed in one with the driving shaft and pulley, has cam paths M cut on its inner surface. In the intermediate member B slots are provided which guide the blocks D carrying the transmitting or driving studs E. The third or driven member C has a series of cam grooves N larger in number than those on the first member A. The rotation of the outer driving member transmits motion through the intermediate sliding member to the inner driven member. In order to vary



the transmission ratio the travel of the driving elements is controlled by oil-operated dashpots consisting of cylindrical bores F formed in an extended part of the intermediate member into which plungers G carried by driving elements fit. At the ends of the bores there are apertures made which can be closed by a ported sliding sleeve H moved from outside the gear-box by the lever J. When the dashpots are oil filled any escape of the liquid is prevented, the driving elements are locked in position and a direct drive is given. When, however, the holes in the bores completely register with those in the sleeve the liquid escapes and the full ratio of transmission made possible by the cam paths M and N can be utilised. At various intermediate positions some ratio of transmission between that of the direct drive and the full reduction of speed will be obtained. There are six other drawings given.—*August 26th*, 1926.

257,104. September 4th, 1925.—Multi-core Electric Cables, C. J. Beaver, Bell-place, Stamford-road, Bowdon, Cheshire; and W. T. Glover and Co., Ltd., Trafford Park, Manchester.

The inventors state that in high-tension multi-core cables breakdowns sometimes occur consequent on air or gases being imprisoned in, or moisture penetrating into, the interstices in the fibrous or hygroscopic fillings and the object of their invention is to remove the cause of such breakdowns. They construct a cable of normal type, except that for the fibrous or hygroscopic fillings they substitute fillings made of strips of vulcanised bitumen fed into the gaps between the conductors. In order to exclude bubbles or films of air between the component parts

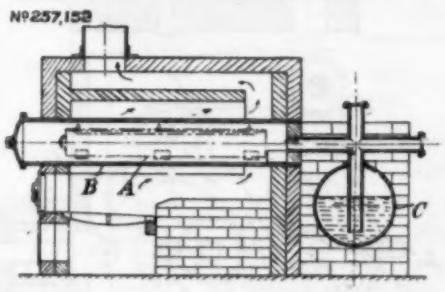


when laying them up together, they are coated with a viscous material such as petroleum jelly, so that there shall be a surplus of such material to exude when the component parts converge. This process may be assisted by compressing all the components together by a light overlapping of insulating fabric or any other solidifying means. Further, the final convergence of the parts may be made in and under the surface of insulating oil or compound.—*August 26th*, 1926.

GAS PRODUCERS.

257,152. December 24th, 1925.—Production of Light Hydrocarbons and Carbon from Heavy Hydrocarbons, Wenzel Knapp, No. 16, Fichtestrasse, Hamburg, Germany; and Wandsbecker Maschinenfabrik und Eisenbauanstalt Bruno Fischer and Carl Steiding, No. 147, Volksdorferstrasse, Wandsbek, Germany.

We are not quite sure if we have read this specification aright, as the expression "carburetting" appears in several places where

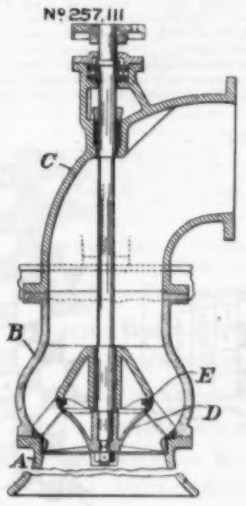


carbonising seems to be meant; but, allowing for this discrepancy, the idea is as follows:—Heavy oil is put in a container A and is introduced into a previously heated retort B. It boils over violently and fills the retort. The volatile constituents are driven off and leave behind pure carbon. The gases are led away into the boiler C, which is filled with heavy oil. This oil is distilled by the heat of the gases and the resulting vapours are led away for condensation and recovery.—*August 26th*, 1926.

PUMPING AND BLOWING MACHINERY.

257,111. September 25th, 1925.—Improvements in or relating to Centrifugal Pumps, Hathorn, Davey and Co., Ltd., and Hugh Ralph Lupton, both of Sun Foundry, Dewsbury-road, Leeds, in the County of York.

The invention described in this specification concerns low-lift pumps adapted to work on a combination of the centrifugal and screw principles. The pump has a three-part casing, the lower portion A of which constitutes the flared inlet to the impeller



which covers the whole of the inlet area. The centre portion B constitutes the guide casing and the upper portion C the delivery chamber and outlet. There is a vertical shaft supported on bearings arranged in the upper portion of the pump casing and also the boss of the guide blades. The impeller D is so constructed as to cause the flow at its exit to have an axial component equal to the radial component in addition to the tangential and radial components usual in centrifugal pumps. The angu-

larly disposed guide vanes E are so designed as to convert the axial as well as the other velocity components into pressure. An impeller and guide blade contour is adopted which gives a wide range of head, and high efficiency without overloading the driving engine or motor. There are eight other drawings.—*August 26th*, 1926.

MACHINE TOOLS AND SHOP APPLIANCES.

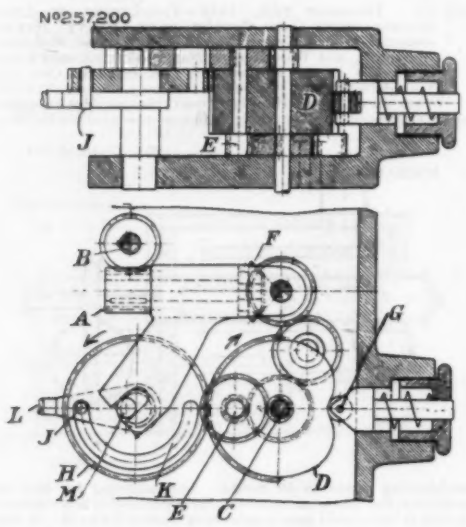
257,156. January 9th, 1926.—Oxy-acetylene Blow-pipes, J. McPherson, 51, Greenfield-street, Govan, Glasgow.

This blow-pipe is intended for work under water. The blow-pipe A itself is normal, but is provided with a by-passed pilot

light B. Around the nozzle there is a hood C which is provided with compressed air, through the pipe D, to keep the water away from the flame. There is a hole in the hood at E for the introduction of the welding rod.—*August 26th*, 1926.

257,200. April 20th, 1926.—Feed Releasing Gear, M. Schütze, 29, Augustusbergerstrasse, Chemnitz, Germany; and Wotan-Werke Akt., 2, Czermaksgarten, Leipzig, Germany.

This invention is put forward as an improvement on what might be described as the "jumping" clutch sometimes introduced in the feed mechanism of a machine tool to prevent breakdown in the event of an obstruction to the feed. It takes the form of a mechanism for withdrawing the driving worm A from engagement with its worm wheel on the feed shaft B. The

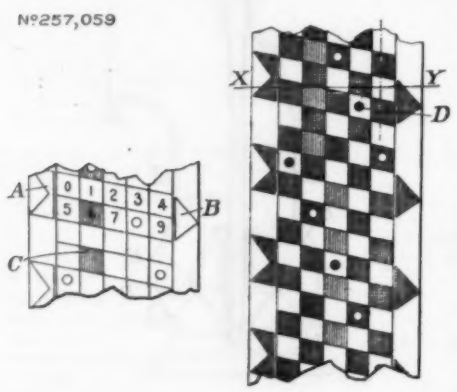


primary driving shaft is shown at C. Round it there is mounted a loose carrier D in which there is journalled one member E of the train of wheels that transmits motion from the primary shaft through the bevel wheels F to the worm A. In the event of the worm being stalled the wheel E tends to rotate the carrier D against the resistance of the spring and presser roller G. Teeth on the periphery of the carrier then rotate the wheel H until the pin J meets the end of the slot K, when the lever L is also rotated and the excentric pin M withdraws the worm A from engagement with the wheel on the feed shaft.—*August 26th*, 1926.

MISCELLANEOUS.

257,059. July 6th, 1925.—Improvements relating to Levelling Staves and like Surveying Instruments, Willem Cornelis van der Sterr, of Mark Buildings, Parliament-street, Cape Town, South Africa; and E. R. Watts and Son, Ltd., of 123, Camberwell-road, London, S.E. 5.

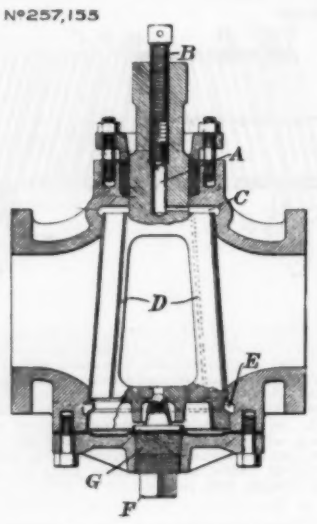
This invention relates to instruments for surveying purposes, and is more particularly adapted to staves such as are employed for levelling purposes and also for long-distance tacheometric or stadia work. As indicated by the illustrations, which show



a portion of the staff such as would be seen by the eye through a telescope giving an inverted image with the cross wires X Y, the face of the staff is divided up into diamond-shaped areas by sloping and vertical lines. The length of the complete staff is 10ft. and the various sections of it are divided off by sloping graduations into divisions equal to one-tenth of a foot, each such division being again divided into equal halves representing the twentieth of a foot, or 0·6in.; the vertical dividing lines are also one-twentieth of a foot apart. At each side of the central marked area there are arrows A and B enclosing each strip of ten squares. These arrows also serve to indicate the way in which the staff is read. The slope of the cross lines is 1 in 5, so that each line from left to right falls one-twentieth of a foot. If the area enclosed by an arrow be further examined it will be seen that it may be divided up into ten diamond-shaped squares, which may be marked as in the illustration left to right, the upper row 0 to 4 and the lower 5 to 9. In actual practice no numbering is employed and the users of the staff rapidly become acquainted with the significance of each diamond-shaped area in the strips shown in the telescope view. An alternate black and white degree marking is employed to facilitate viewing, also to read integral feet a special area is marked in red for each distinct foot of the staff. In the example given it is area 6, which would read 6 integral feet. In a similar way the first decimal place is obtained by noting the position of a circle placed in one of the squares. In the illustration it is in the fourth square on the bottom strip, indicating 0·8ft. or a total reading of 6·8ft. A third decimal place can be read by noting the square, which is most nearly bisected by the cross wires. This in the illustration given is the fifth area on the top strip, indicating 0·04ft., or a total reading of 6·84ft. Staffs may be graduated in metres or feet and markings other than those referred to used.—*August 26th*, 1926.

257,155. January 6th, 1926.—Plug Valves, *H. Wade*, 111, *Hatton-garden, London, E.C.* 1.

The special feature about this plug valve is the fact that the plug can be lifted from its seat if it gets stuck. The stem of the valve is bored, as shown at A, and the hole is filled with grease,



which can be compressed by the screw B. The grease is forced into the recess C and its pressure releases the plug. Some of the grease flows down the grooves D D into the annulus E and lubricates the rubbing parts. The screw F and elastic packing G are used to hold the plug up against its seating.—*August 26th*, 1926.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

Faraday Society.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Discussion on "Physical Phenomena at Interfaces, with Special Reference to Molecular Orientation." 2.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, Westminster, London, S.W. 1. Paper, "Notes on Transformer Testing and Test Plant," by Mr. L. Smith. 7.30 p.m.

SATURDAY, OCTOBER 2nd.

Institute of British Foundrymen: Lancashire Branch.—Houldsworth Hall, 90, Deansgate, Manchester. Presidential address, "Notes on Foundry Practice," by Mr. S. G. Smith. 4 p.m.

Institution of Municipal and County Engineers.—South Midland District meeting at Letchworth. 11 a.m.

MONDAY, OCTOBER 4th.

Bradford Engineering Society.—Technical College, Bradford. Inaugural address, "The Evolution of the Factory Power Plant," by Alderman J. W. Longley. 7.30 p.m.

Institute of Transport.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Presidential address by Mr. R. H. Selbie. 5.30 p.m.

Institution of Automobile Engineers.—The College, Loughborough. Loughborough Graduates' business meeting. 7 p.m.

Society of Engineers.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The History of Artificial Lighting," by Mr. W. J. Liberty. 5.30 p.m.

TUESDAY, OCTOBER 5th.

Engineering Golfing Society.—R.A.C. Country Club, Woodcote Park, near Epsom, Surrey. Autumn meeting. 10 a.m.

Institute of Metals: North-East Coast Local Section.—Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Paper, "Preparation and Metallography of Metal Filaments," by Dr. C. J. Smithells. 7.30 p.m.

Institution of Automobile Engineers.—Royal Automobile Club, Pall Mall, London, S.W. 1. Presidential address, "The Debt of the Country to the Automobile," by Mr. H. Kerr Thomas. 8 p.m.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. Presidential address by Mr. A. J. Campbell. 7.30 p.m.

Institution of Heating and Ventilating Engineers.—Caxton Hall, Westminster, London, S.W. 1. "Panel Heating," by Mr. A. H. Barker. 7 p.m.

WEDNESDAY, OCTOBER 6th.

Institution of Automobile Engineers: Western Centre.—Merchant Venturers' Technical College, Bristol. Presidential address, "The Debt of the Country to the Automobile," by Mr. H. Kerr Thomas. 6.45 p.m.

Institution of Sanitary Engineers.—Caxton Hall, Westminster, London, S.W. 1. Reception and conversazione. Paper, "Housing Problems, with Special Reference to Subsidies and Rural Needs," by Mr. G. B. Chilvers. 6.30 p.m.

University of London.—University College, Gower-street, London, W.C. 1. Public lecture, "The Engineering Plant at University College Hospital," by Mr. A. H. Barker. 7 p.m.

THURSDAY, OCTOBER 7th.

Royal Aeronautical Society.—7, Albemarle-street, London, W. 1. Lecture, "Aero-engine Fuels of To-day and To-morrow," by Colonel the Master of Sempill. 8.30 p.m.

FRIDAY, OCTOBER 8th.

Junior Institution of Engineers.—39, Victoria-street, Westminster, London, S.W. 1. Paper, "A Survey of Modern Airless Injection Oil Engines," by Mr. N. J. Griffin. 7.30 p.m.

MONDAY, OCTOBER 11th.

Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Chairman's address, by Mr. S. E. Flack. 7.30 p.m.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Presidential address, "The Debt of the Country to the Automobile," by Mr. H. Kerr Thomas. 7.30 p.m.

TUESDAY, OCTOBER 12th.

Institute of Marine Engineers.—85-88, The Minories, Tower Hill, London, E. 1. Paper, "Double-acting Oil Engines," by Mr. W. G. Burn. 6.30 p.m.

Institute of Metals: Birmingham Local Section.—The Engineers' Club, Waterloo-street, Birmingham. Address by the Chairman, Mr. Arthur Spittle. 7 p.m.

Institution of Automobile Engineers.—Queen's Hotel, Birmingham. Joint dinner of the Birmingham, Coventry and Wolverhampton Centres. Presidential address, "The Debt of the Country to the Automobile," by Mr. H. Kerr Thomas. 8 p.m.

THURSDAY, OCTOBER 14th.

Institute of Metals: London Local Section.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Address by the Chairman, Mr. A. H. Mundey. 7.30 p.m.

Institution of Automobile Engineers.—Cavendish Café, Cornmarket, Derby. Derby Graduates' meeting. Discussion on "Spiral Bevels *v.* Worm Drive for Rear Axles." 7.30 p.m.

FRIDAY, OCTOBER 15th.

Diesel Engine Users Association.—Caxton Hall, Westminster, London, S.W. 1. Paper, "A Note upon the Obligation of the Ironfounder to Diesel Engine Users," by Mr. H. J. Young.

TUESDAY, OCTOBER 19th.

Institute of British Foundrymen: Lancashire Branch. Burnley Section.—Municipal College, Ormerod-road, Burnley. Paper, "Elementary Science for Practical Moulders," by Mr. A. Jackson. 7.15 p.m.

WEDNESDAY, OCTOBER 20th.

Newcomen Society.—Iron and Steel Institute, 28, Victoria-street, London, S.W. 1. Presidential address, "Observations on the Rise and Progress of Manufacturing Industry in England," by Mr. Rhys Jenkins. 5.30 p.m.

FRIDAY TO SATURDAY, OCTOBER 22nd to 30th.

Motor Show.—At Olympia, London, W. 6. 10 a.m. each day.

CONTRACTS.

Fuller's United Electric Works, Ltd., Chadwell Heath, London, have obtained a contract for 17,400 plates for train lighting accumulators for the Bombay, Baroda and Central India Railway.

The Metropolitan-Vickers Electrical Company has received an order from Caledonian Collieries, Ltd., New South Wales, for a large electric winder with Ward-Leonard control for installation at the Aberdare Central Colliery. The set is required to wind a net load of 7½ tons of coal from a depth of 1260ft. at the rate of 490 tons per hour. The winder will be driven by two direct-current motors having a combined capacity of 4500 horse-power r.m.s. and capable of dealing with a peak load of 11,250 horse-power. The motors will operate at 57 revolutions per minute and will be direct coupled to a cylindrical drum of 14ft. diameter. The equipment is so designed that an output of two-thirds normal can be obtained with only one of the driving motors operating. Direct current for the winding motors will be supplied by a fly-wheel motor generator set consisting of a 1500 horse-power induction motor driving two generators, each of 925 kilowatts capacity, with an overhung exciter and a 12½-ton fly-wheel. A Lilly overspeed and overwind protective device is to be fitted on the equipment. The mechanical parts of the winder will be supplied by Messrs. Fullerton, Hodgart and Barclay. While the equipment is not by any means so large as some other electric winding plant now being manufactured at the Trafford Park works of the Metropolitan-Vickers Electrical Company, the winder motors are of considerable size. Their overall diameter is 13ft. 4in. and their base 15ft. 6in. The armature diameter is 9ft. The total weight of each machine is 68 tons, of which the armature, which is the heaviest separate lift, weighs 29 tons. The motors will be similar, as regards weights and dimensions, to machines installed by the Metropolitan-Vickers Electrical Company for the Rand mines and the Chinese Engineering Company and to the motors of an equipment now being completed for the Carlton Main Colliery Company, which, when installed, will be the largest electric winder in this country.

"Teknisk Tidskrift."—We must congratulate the *Teknisk Tidskrift* on its enterprise in producing its number for August 28th entirely in English in celebration of the visit of the Iron and Steel Institute to Sweden. Besides notes on the recent meeting and on that of 1898, it contains several excellent original articles on Swedish mining.